Flight Surgeon's NEWSLETTER

(This material is for the information of Navy flight surgeons only and does not necessarily reflect endorsement by the Navy or the Naval Aviation Safety Center.)

SINGLE EJECTIONS FROM DUAL COCKPIT A/C

As a supplement to our ongoing study of "Ditch or Eject" it has been important to compile statistics concerning single ejections from dual ejection seat aircraft. Pilot/navigator decisions, squadron operating policy and sequence ejection capability have undoubted influence on the success/failure rate of such ejections.

Personal knowledge of certain events as well as statistics kept at the Safety Center indicate that some cockpit occupants have conditioned their responses to not eject on cold cat shots and related situations. Decision to eject is affected by preconceived decisions, free floating feelings of "I'll decide when the time comes," knowledge of the equipment and confidence in it, fear and its opposite, bravery, lack of circumspection, misdiagnosis, geographic location and personal debility. It is impossible to determine the extent of the impact of these various influences on the success rate; indeed, it is impossible to describe carefully whether the ejection situation was "in the envelope" or "out of the envelope" even when altitude, attitude, airspeed, sink rate, type of ejection system and maintenance quality are known in the close ones.

The effect of the ejection sequence is largely an unknown quality. There is some evidence that some navigators owe their lives to pilot actuation of their ejection seats. No pilot wants the navigator to have the capability of ejecting him out of the aircraft; however, dual ejection systems with navigator sequencing are installed in the RA-5C, F-4 and T-2. The following statistical summary provides information for your consideration:

SINGLE EJECTIONS FROM DUAL COCKPIT A/C (TWO OCCUPANTS)

CY 1961-1967

TF-9

Ejectee	Other Occupant
Front cockpit	Dual pilot did not eject - fatal
Rear cockpit	Pilot did not eject - fatal
Front cockpit	Passenger did not eject - lost
Front cockpit	Instructor did not eject - fatal
Front cockpit	Instructor stayed with a/c until it stopped on runway
Rear cockpit	Instructor did not eject - fatal

(continued from page 1)

Ejectee	Other Occupant
T-1	
Observer	Pilot could not eject - fatal (pins left in seat)
Passenger	Pilot landed aircraft
Observer	Pilot did not eject - fatal
A-5	
RAN	Pilot landed aircraft
RAN	Pilot landed aircraft
RAN	Pilot landed aircraft
RAN	Pilot landed aircraft
A-6	
B/N	Pilot landed aircraft
F-4	
RIO (Lost) ejected for no apparent reason at 27,000 feet over water	Pilot landed aircraft
RIO	Pilot landed aircraft
Pilot	RIO lost
RIO	Pilot landed aircraft
Pilot	RIO stayed with a/c unaware of pilot ejection (on ground). OK.
RIO	Pilot landed aircraft
RIO	Pilot did not eject-<u>fatal</u>-hypoxia suspected
RIO	Pilot did not eject - fatal
Pilot - fatal - out of envelope	RIO did not eject - fatal
RIO	Pilot did not eject - fatal
RIO	Pilot landed aircraft
RIO	Pilot landed aircraft
RIO	Pilot landed aircraft
RIO	Pilot landed aircraft
RIO	Pilot landed aircraft
Pilot	RIO did not eject - fatal
RIO	Pilot landed aircraft
RIO (Inadvertent)	Pilot thrown out - fatal
RIO	Pilot landed aircraft
RIO (Vietnam)	Pilot landed aircraft
Pilot	RIO did not eject - fatal
RIO	Pilot did not eject - fatal
Pilot	RIO failed to eject - fatal
Pilot	RIO failed to eject - fatal
Pilot	RIO failed to eject - fatal
Rear Seat Instructor	Student pilot landed aircraft
RIO	Pilot failed to eject - fatal
Rear Seat Instructor	Student pilot landed aircraft

FLIGHT SURGEON'S CRASH KIT

The following description of a flight surgeon's crash kit developed by LCDR Al Adeeb, MC and LCDR J. B. Boorstin, MC, Cecil Field, is taken from ComFairJax's safety council minutes of the 4th quarter FY 67. The minutes state that the kit has been approved by BuMed.

This miniature over-the-shoulder crash kit was devised to replace heavy, over-sized kits for use in accidents in which reaching the aviator is a problem, such as in swampy, boggy terrain and where there are tall trees. The kit contains a PRC-49 radio modified to transmit and receive on 282.8 MCS to permit communications with the helicopter.

The kit also contains the following medical items: 2 wire ladder splints; 1 plastic inflatable arm splint; 2 medium first aid dressings; 1 tourniquet; 5 morphine tartrate syrettes (1/4 gr.); 2 2½ cc. disposable syringes with 23 gauge needles; 1 plastic pharyngeal airway; 5 Weck razor blades; 1 surgical knife handle; 2 pkgs of #11 scalpel blades; 5 ice aqueous epinephrine cartridge needle units; 1 #6 tracheotomy tube; 1 cardiac needle.

The kit weighs approximately five pounds. It is contained in a relatively waterproof WW II surplus Air Force field medicine package with an adjustable shoulder strap so that it can be carried easily on all helo hoists with both hands to be free.

Presentation of the kit to the safety council was by Dr. Boorstin.

* * *

QUOTED FROM AN MOR:

"Although it seems that it should not be necessary, it might be well for a squadron flight surgeon to periodically remind his aviators that their physical exams must be done by a flight surgeon or aviation medical examiner even if they should become attached to a unit without a flight surgeon."

* * *

SURVIVAL RADIO AND STROBE LIGHT TESTERS

Two instruments now available in WestPac are the TS2530/UR battery tester and the TS2531/UR "go-no-go" transmitter tester.

The battery tester is a self-contained unit designed to test the batteries of ACR RT-10 and AN/URC-10 radios, the ACR SDU-5/E strobe light, and, when a special adapter is used, the AN/PRC-63 radio. (It also tests the Air Force AN/URT-21 and AN/URT-27 beacon sets.) The tester requires no power to operate other than that which is received from the battery under test. The battery tester represents as a minimum, a nominal transmitter load to the battery under test.

The life of the battery is determined from the graphs supplied for each battery type. Data cards and an operating instructions card come with the tester. The tester is calibrated and encapsuled at time of manufacture; no calibration of any sort is required for the life of the equipment.

The "go-no-go" transmitter tester is also a self-contained unit requiring no external power. It provides a method of operationally checking the AN/URC-11, AN/URC-10 and RT-10 radios, as well as the Air Force AN/URT-21 and AN/URT-27 beacon sets. The output is registered on a meter which indicates either "Accept" of "Reject." Also provided is an audible output to indicate proper tone modulation of the radio or beacon set under test. This tester is for detecting failed or severely degraded equipment only.

All electronics circuitry on the tester is calibrated and encapsuled at time of manufacture and the read-out meter is hermetically sealed. Thus the tester either functions or does not function. No service, maintenance or calibration is required for this tester. Normally, use of this tester will not cause interference if instructions are followed. However, if the operation of extremely sensitive equipment is affected by the presence of the tester, this interference may be reduced or eliminated by grounding the tester frame from the terminal provided.

Personal Survival Equipment Crossfeed, December, Part 1, carried pictures and extensive information on these two testers.

As of this writing, 50 each of the battery tester and "go-no-go" tester have been sent to COMFAIRWESTPAC, NAS Atsugi.

* * *

4. External Factors Affecting Adaptation to the Environment: It has long been noted that people in isolated situations -- arctic camps, prisons, patients in iron lungs and survivors at sea -- have hallucinatory and delusional experiences. Any environment where there is constancy of the surroundings can provoke a sensory deprivation experience which can produce changes of great emotional intensity and psychotic-like illusions. These effects can be noted in even a few hours of sensory deprivation. The main effects are (1) directed and organized thinking becomes difficult; (2) there is increased suggestibility; (3) a feeling of a need for outside stimuli and body motion becomes intense; (4) there is great time distortion; (5) in prolonged experiences, hallucinatory experiences are not uncommon.

BREAK-OFF PHENOMENON

In aviation, an extreme example of the effect of sensory deprivation is the so-called "break-off phenomenon." This is a phenomenon noted primarily when flying alone at altitudes above FL 300 and when there are no unusual demands on the pilot for controlling the aircraft. Some pilots will note feeling of detachment from the earth and feel that they, themselves, even without the airplane, are floating off into space. Pilots who experience this phenomenon are either very upset by it or exhilarated by it, but few, if any, go out of their way to seek it.

In this instance we might say that the pilot is no longer fused to the plane but has transcended boundaries. As quoted by Graybiel and Clark in their 1956 study, "The Break-Off Phenomenon," Bridgeman, the X-15 pilot vividly describes the experience of fusion and break-off:

"Fifty-nine thousand, sixty-thousand, reeling off sixty-one thousand. I have left the world. There is only the ship to identify myself with; her vibrations are my own. I feel them as intensely as those of my body. Here is a kind of unreality mixed with reality that I cannot explain to myself. I have an awareness that I have never experienced before, but it does not seem to project beyond this moment...and with this adrenalin inflicted state floats the feeling of detachment."

MOTOR ACTIVITY DRIVES

There are other more psychologic aspects of man's relation to the aerospace environment. Psychologically speaking, there are drives to motor activity. The discharge of those motor drives may be of major motivational significance in flying. Visualize the pilot sitting in the cockpit. He moves very little. In fact, he is almost immobilized by the equipment and restraining straps yet he is producing great motion of his aircraft. He is transferring his motor activity to the plane and thus releasing those motoric impulses which must be released. His ability to fuse himself perceptually with the plane permits motor expression and may account

for much of the satisfaction he derives from flying. A man who fears uninhibited motion and its emotional accompaniment cannot adapt to or enjoy flying.

The initial design specifications for man were for a two-legged creature, without wings, who would function optimally walking on the ground in daylight. Through the selection process for flight training the Navy receives trainees who are maximally suited to flying, both physically and psychologically. Through training and practice these men become adapted to the aerospace environment. It is only by continued exposure to those aspects of flight that are uncomfortable to an aviator that he learns to master and control them. Through such mastery we will be able to maintain the most professional pilots in the world in a constant state of readiness.

Bibliography

Bennett, D. R., Capt. MC, USAF, "Sleep Deprivation and Major Motor Convulsions," Neurology, 13:953-958, November 1963.

Clark, B., Ph.D., and Graybiel, A., Capt., MC, USN, "Disorientation: A Cause of Pilot Error," Research Report No. MM 001 110 100.39, BuMed, 2 March 1955.

Clark, B., Ph.D., and Graybiel, A., Capt, MC, USN, "The Break-Off Phenomenon: A Feeling of Separation from the Earth Experienced by Pilots at High Altitudes," BuMed Research Report No. 43, 6 August 1956.

Luby, E. D., M.D., et al, "Sleep Deprivation: Effects on Behavior, Thinking, Motor Performance, and Biological Energy Transfer Systems, Psychosomatic Medicine, 22:182-192, May-June 1960.

Solomon, P., M.D., et al, "Sensory Deprivation: A Review," American Journal of Psychiatry, 114:357-363, October 1957.

Wexler, D., M. D., et al, "Sensory Deprivation: A Technique for Studying Psychiatric Aspects of Stress," AMA Archives, Neurology and Psychiatry, 79:225-233, February 1958.

Williams, H. L., Lubin, A., and Goodnow, J. J., "Impaired Performance with Acute Sleep Loss," Psychological Monographs, General and Applied, 73:1-26, 1959.

PSYCHOPHYSIOLOGIC ASPECTS OF FLIGHT

By Dr. Gary Tucker

In the following article, the psychophysiologic and environmental factors that affect the efficiency of the aviator's responses are discussed at length by Dr. Gary Tucker, psychiatrist and former lieutenant commander in the Medical Corps. Dr. Tucker was assigned to the division of psychiatry and neurology, U. S. Naval Aerospace Medical Institute, Pensacola, at the time he wrote this article. He is at present a member of the faculty of the School of Medicine, Yale University.

Nowhere is the interplay of environment and human behavior more vividly highlighted than it is in aviation (and space travel - Ed.). The aviator is continually and simultaneously responding to events that occur in his internal or bodily environment and the external or aerospace environment. For purposes of our discussion we will break the general topic down into 1) how man orients himself on earth, 2) how he orients himself in "aerospace" and 3) and 4) internal and external factors affecting adaptation to aerospace and other environments.

1. Adaptation to Everyday Environment (Orientation in Space):
The sensory inputs of sight, hearing, balance, pain, touch and muscle sense are integrated centrally to give us a mental and often unconscious impression of our body's position in space. Sensory inputs are also affected by emotional states. For instance, when we are tired or depressed, our limbs feel heavy; when we are elated we feel light and buoyant. Because of the variability of emotional states and the demands of the environment, the image we have of our body is constantly changing. Through trial and error and practice we develop our ability to move effortlessly in space. Our success leads to a sense of perceptual-motor control of the environment.

In our daily lives, we have complete perceptual-motor control of our environment. We give little conscious thought to our action. Through learning and habit, we automatically judge distances, walk across rooms and up stairs. We unconsciously know where our arms and legs are in relation to space. There are times, though, when these perceptual-motor skills go awry. For example, when we walk down stairs and find that we estimated one more step than there actually is, and we bring our foot down quite hard and unexpectedly, we immediately wonder what happened, what went wrong. For a brief moment, we lose our perceptual-motor control of the environment; we become disoriented in space. This experience creates anxiety. We may be careful on stairs for a few days, but it is usually quickly forgotten except when we use those same stairs.

A more vivid example of anxiety created by the loss of perceptual-motor control is when we are about to go to sleep and suddenly we have the feeling that we are falling. The resulting anxiety does not completely leave until we are fully aware and reassure ourselves that we are at home in our own beds. However, these experiences are rare and we are usually comfortable with our bodies and movements through space. The anxiety from disorientation in our daily lives is qualitatively the same as that associated with disorientation in flight.

2. Adaptation and Orientation to the Aerospace Environment:

Adaptation to the aerospace environment is a vivid, practical demonstration of the blending of perceptual-motor mechanisms and emotions. The new flight student suddenly finds himself in a very strange perceptual environment. Initially, everything is alien to him -- the plane seems to have a will of its own, the clouds are enormous and nothing on the ground looks familiar.

In the cockpit on the first few flights, the student is rigid. He seems to feel that if he moves or jostles the instruments, the aircraft will come tumbling from the sky. His grip on the controls is like a "death grip." He seems to be trying to hold the plane in the air by this one control.

As the student's training progresses, he begins to feel that the plane is acting as he commands; the plane is doing what he wants. As the student finds the plane acting more at his command, much as his arms and legs do when on the ground, he not only feels more comfortable but he has also incorporated the physical aspect of the plane into his own body image. We might say that he is now fused with the aircraft on a perceptual-motor level. He no longer thinks of where the wings are or where the landing gear is, he knows -- just as he knows on the ground where his arms and legs are in relation to objects around him.

When the student finds that he can maneuver the aircraft at his will, and thereby himself, through the three-dimensional environment, he has achieved perceptual-motor control of the environment. But, to do this, the student must feel that he is fused with the plane, that the plane is acting as a part of himself.

FLYING AS A PASSENGER

A different feeling is experienced when one is flying as a passenger. Many experienced pilots feel anxious when they are passengers in commercial aircraft. They can only achieve some degree of comfort when they go over the flight procedures in their own minds as they imagine the pilot himself is doing. The plane in this situation is nothing more than a vehicle, a bus. This feeling, however, changes if we, ourselves, take the controls.

The plane then becomes something different. Our relationship to it is much more personal -- the boundaries and image of the plane seem to fade away as we are lost in the process of flying. The aircraft is no longer a conveyance but is more a part of ourselves. The physical sense of separateness seems to blur away, leaving a feeling of oneness.

As the student progresses through training, each new phase -- instrument flying, formation, carrier landing -- presents a new perceptual task which he must master in the same manner of perceptual-motor control and fusion. Once these tasks are mastered, he gives them little thought. If the pilot is not particularly comfortable in one phase of flying, it is frequently due to the fact that he has never been able to adequately "feel" in control of the situation and, thereby, in control of the aircraft. The most common area of difficulty in this respect is instrument flying.

3. Internal Factors Affecting Aerospace Adaptation (Vertigo, Perceptual Illusion, Sleep Deprivation): In the early stages of learning to fly, and when learning new flying skills, the student is in a continual state of disorientation. Without the sense of perceptual-motor control of the environment, he experiences what can be termed perceptual anxiety. A person struggling to awaken from a deep sleep has perceptual anxiety until he is oriented and remembers what has happened.

The anxiety in learning a motor task is soon forgotten, once we have mastered it, whether it be swimming, riding a bicycle or flying an airplane. However, when the pilot becomes subject to the perceptual illusions associated with flying such as false sensations of rotation or seeing the plane banking left but feeling it bank right, the plane then again becomes something alien. The fusion with the plane is broken. The pilot's sense of control of environment is lost and anxiety results. Disorientation, (pilot's vertigo) can lead to the breakdown of habit patterns and, further, to accidents.

DISORIENTATION EXPERIENCES

Disorientation experiences can be grouped into four broad categories. (The following material is drawn from "Disorientation: A Cause of Pilot Error" by Clark and Graybiel.)

1. Visual Illusions - These include, for example, autokinesis (the apparent motion of a light source at night or in dim light), and the problems of relative motion (the feeling that objects you are approaching, such as other aircraft, are moving but you are not).

2. Non-Visual Illusions - Failure to perceive rotation, or to perceive rotation when there is none (oculogyvic illusion and Coriolis effect), or that one is climbing or diving when one is flying straight and level but accelerating (oculogravic illusion).

3. Conflicting Sensory Cues - For example, the feeling of banking to the right when the visual horizon indicates that the aircraft is flying level.

4. Dissociational Phenomena - This includes such things as loss of time or directional sense and "fascination" with one particular aspect of flight.

Due to diminished visual contact, all of these illusions are more common at night and in rain, fog and haze (particularly when flying over water). Other internal factors are (1) the pilot's instrument proficiency; (2) his confidence in instrument flying; and (3) his physical condition, particularly in relation to fatigue, boredom and sleep.

SLEEP DEPRIVATION

The effects of sleep deprivation, combined with a stressful environment, can be marked and surprising. World War II troops who were kept awake nights on end by harassing enemy action were frequently incapacitated by psychotic-like behavior. Many a college student who loses sleep during a stressful examination period experiences a brief psychotic-like reaction. (The term "psychotic-like" is used because in most of these people there is no hint of historical or personality proneness to psychosis and the reactions usually clear up after adequate sleep.)

It has long been noted that a temporary state similar to psychosis can be developed with sleep deprivation. In subjects deprived of sleep anywhere from 72 to 220 hours, a wide variety of emotional symptoms (irritability, expansiveness, grandiosity, paranoid states, visual hallucinations and rage attacks) are noted. More pertinent for our work with aviators is the fact that, even after 24 hours of sleep deprivation, we can note changes in length of reaction times and increased errors in psychomotor performance.

In the sleep-deprived person, the most common symptom is unevenness of performance as distinguished from a straight-line declination of performance. This unevenness of performance is due primarily to lapses of attention. If the subject performs tasks at his own pace (subject paced), his reaction time is simply increased; however, if the task is paced by the experimenter (time limit), there are increased errors. The implication of this for aviation personnel are self-evident.

In addition, lack of sleep not only alters the person's internal environment with regard to psychomotor performance, but sleep deprivation may precipitate seizures by lowering the convulsive threshold.

Flight Surgeon's NEWSLETTER

(This material is for the information of Navy flight surgeons only and does not necessarily reflect endorsement by the Navy or the Naval Aviation Safety Center.)

Status of Escape System Improvement Development Programs

Subject: A-3B, RA-3B and EKA-3B Aircraft, Tractor Rocket Aircrew Extraction Escape System

Brief:

1. Analysis of data from contractors test program has indicated that installation of subject escape system was feasible and requests were forwarded to CNO for funding to support the program to completion.

2. CNO reply to NAVAIR has indicated that there are no funds at present to support this program, and that it will be reviewed in reapportionment of FY 69 funds in July 1968 to see if funding can be made available at that time.

3. The impact of this action on the previously estimated time of 75 weeks for kit delivery after ATP to contractor has not been determined.

Current Capability - Manual Bailout 400' above G.L.
Planned Capability - Zero speed at zero altitude

Subject: A-4 Escape System Performance Improvement

Brief:

1. Developmental, testing and prototype installation (in 3 NATC aircraft) of Airframe Change 359 for A-4 aircraft has been completed and kits are ready for delivery for incorporation in operational aircraft. Prototype installation is scheduled at NARF, Jacksonville.

2. The A-4 escape system, with AFC 359 installed, has during tests demonstrated repeatable/predictable zero/zero escape performance and shows great improvement in escape capability under high aircraft sink rate and adverse attitude ejection conditions which would be prev lent during carrier operations and yet maintains safe escape capability at VMAX of the aircraft.

3. Scheduling of incorporation of this change in Fleet aircraft has been delayed due to lack of spares support in other than kit form. ASO has taken action on an

expedited basis to provide support on a detailed basis.

Current Capability - 90 kts. on the deck
Planned Capability - Zero speed at zero altitude

Subject: Martin-Baker MK-7 Zero/Zero Escape System Program

Brief:

1. Rocket propulsion systems are being added to the Martin-Baker escape system in F-4, F-8 and A-6A aircraft to provide an improved escape capability under conditions of low speed, low altitude, adverse attitude and high sink rate.

2. Individual program status is as follows:

(a) F-4 aircraft MK-H7 Sequenced Escape System

The escape system test program has been completed. The MK-H7 sequenced system was incorporated in production aircraft starting in December 1967. The first retrofit kits were delivered in November 1967 and are being incorporated by NARFS, Cherry Point and San Diego.

Present Capability (MK-H5 system) 130 kts. on the deck
New Capability (MK-H7 system) zero speed at zero altitude

(b) F-8 aircraft MK-F7 escape system

Median speed testing of the system has been completed. One (1) high speed test and two (2) zero/zero tests are scheduled to be conducted in early April and kits deliveries are planned to begin in May 1968.

Present Capability (MK-F5 system) 120 kts. on the deck
Planned Capability (MK-F7 system) zero speed at zero altitude

(c) A-6 aircraft MK-GRU7 escape system

Anticipated production delivery date of A-6 aircraft with the MK-GRU7 escape system is February 1969 with retrofit kits available in May 1969.

Present Capability (MK-GRU5 system) 100 kts. on the deck
Planned Capability (MK-GRU7 system) zero speed at zero altitude

Subject: TF/AF-9J Escape System Program

Brief:

1. CNO has authorized funds for improving the performance capability of the TF/AF-9J escape system. To accomplish this at the earliest time, in view of limited remaining aircraft project service life and within funds allotted, the present Martin-Baker seats are to be updated and equipped with a rocket assisted

propulsion unit. This propulsion system is similar to that currently being incorporated in F-4 and F-8 aircraft escape systems and will provide for emergency escape at ground level from 0 to 450 knots airspeed.

2. Contract negotiations with Martin-Baker are currently in process. Target date for completion of required qualification tests and availability of retrofit kits is fall of 1969.

Present Capability - 100 kts. on the deck
Planned Capability - zero speed at zero altitude

Subject: T-28

Brief:

1. The proposed program to incorporate an automated aircrew escape system in Navy T-28 B/C aircraft has progressed through an evaluation of four contending systems to the selection of a system and recommendation to CNO that the program be approved and funded.

2. System specifications defining the requirements for cockpit air conditioning, the aircrew escape system, escape system testing, and data requirements currently are being finalized by the Naval Air Systems Command in anticipation of a CNO decision on availability of fiscal year 1969 funding for this program.

3. The proposed incorporation of an automated aircrew escape system in T-28 B/C aircraft will provide a significant increase in the escape capability afforded aircrewmen -- from a current 2,000 feet above terrain in level flight, to zero speed on the ground and, also, to low-level flight under sink rate conditions.

Subject: T-33

Brief:

1. It is anticipated that the delayed retrofit incorporation of T-33B ejection seat modification kits will commence in March 1968. Most recently, problems encountered during lot acceptance testing of the system rocket catapults necessitated changes in design to correct latent discrepancies previous testing had not uncovered.

2. The modified escape system is designed to provide aircrewmen with a 90 kt., ground level escape capability.

3. At the present time, programs are underway to improve (a) type and quantity of personal survival equipments which the aircrewman may carry or which may be stowed in or on the ejection seat, and (b) escape system performance -- perhaps in the manner of the A-4 escape system update program.

- Presented by NavAirSysCom at
6th Aviation Contractors' Safety Representatives
Conference, Norfolk, Virginia, 12-14 March 1968

CI-2 Smoke Abatement Additive - A Highly Toxic Liquid - Requires Special Precautions

Certain naval and Marine aircraft have been fitted with engine exhaust smoke abatement systems in which a smoke abatement liquid (CI-2) is mixed with jet fuel. This is for the purpose of helping reduce aircraft combat losses by eliminating "telltale" exhaust trails. Personnel who maintain and service these systems must have a thorough knowledge of the equipment involved and of the basic medical safety precautions in handling, storage, and disposal of the highly toxic CI-2 liquid.

CI-2 is a complex organic compound containing about 25% manganese by weight. It is a dark orange liquid with a faint pleasant odor. It is soluble in jet fuel and other solvents, has a flash point of 230°F, and decomposes when exposed to light. The liquid is highly toxic by all routes of exposure - by inhalation of vapors, ingestion of liquid, and by absorption through the skin. Human exposure data is sparse since the material has been introduced only very recently. Experimental animal exposure data indicates that the toxicity of CI-2 is similar in nature to tetra ethyl lead. The primary site of effect is the central nervous system. Acute intoxication of animals has produced tremors, weakness, slow respirations, occasional convulsions and coma.

The first known human over exposure to this material occurred very recently during air operations on the flight deck of a carrier. A maintenance control officer was exposed to vapors of CI-2 leaking from an aircraft. It was reported that he inhaled sufficient vapors to produce the symptoms of a strong metallic taste in the mouth, nausea, and headache.

The CI-2 liquid is received in 10 gallon steel drums, put into a special dispensing cart aboard ship and is "hand pumped" from the cart into small additive tanks in the aircraft through flexible hoses fitted with special couplings to prevent leakage. In spite of precautioning features built into this system there are reported instances of uncontrolled spillage, leakage, and spray of CI-2 liquid, particularly during servicing of the aircraft. One carrier reports that four incidents or overservicing aircraft resulted in excess of one quart of CI-2 being sprayed from an overflow bottle. The need for protective clothing is evident since the liquid is readily absorbed through the skin.

Recent messages from NAVAVNSAFECEN, NAVAIRSYSCOM, NAVSHIPS and BUMED have stressed precautionary measures, including compliance with INT NAVAIR INST 536-1 of 1 Dec 1967 (Smoke Abatement Additive: Safety-Storage-Handling-Disposal). Emphasis should be placed on preventative measures to avoid skin contact and inhalation of vapors, and preventing spills. Recommended protective clothing for normal work involving potential spills and contamination are impervious gloves, boots, apron and organic vapor respirator (such as Mark V full face mask). Note that if odor of the material is present, a mask should be worn. When cleaning up "gross" spills in confined poorly ventilated spaces, total coverage is recommended. This would include impermeable coveralls, boots, gloves, protective hood (such as rocket fuel handlers clothing), oxygen breathing apparatus and the use of exhaust ventilation. Immediate removal of contaminated clothing, thorough washing of contaminated skin, and decontamination of clothing and equipment as per INT NAVAIR INST 536-1 is essential.*

Containers and carts should be labeled "poison" and other signs installed which call attention to the hazard. With strict adherence to proper precautions further cases of intoxication can be prevented.

* For example, contaminated skin should be cleaned with jet fuel, kerosene, or dry cleaning solvent (GSA Stock #906850 or 9G-6850-264-9038), then washed thoroughly with soap and hot water.

* * *

Anymouse Report on Flight Physicals

The following Anymouse Report was recently received at the Safety Center. While recognizing that administrative and medical emergencies can affect the best-planned dispensary organizations, we think this letter's value is that it reminds us that the flight physical can be an opportunity to strengthen the pilot-flight surgeon relationship. The frank and confidential discussion of personal problems in a thoroughly private situation, to use the writer's words, can contribute to the alleviation and possible solution of worries before they become big enough to constitute a threat to safe flying.

> Flight surgeons on the days of physicals are not assigned the single duty of conducting physicals or, if they are so assigned, they are given several other tasks which interfere. During my last flight physical, a half-dozen pilots waited one hour for a flight surgeon. When one arrived from obstetrics (the one assigned could not be reached) and started the routine, word came for him to return to O.B. for delivery. After another hour-long wait, a different flight surgeon arrived to complete the exam. By this time it was 1600 and all concerned were primarily interested in a speedy completion of the exam. In 15 minutes the surgeon perfunctorily examined all of us. His main interest seemed to be discussing a new dual control aircraft his squadron had received.
>
> This experience is not unusual, either here or at several other stations with which I have been acquainted. I recommend that flight physicals be conducted by a flight surgeon exclusively assigned for the day to exams. Secondly, the surgeon should be from the same air group/wing as the pilots to promote a more relaxed atmosphere. Moreover the surgeon's examination should be thoroughly private so that personal problems may be discussed frankly and confidentially. Lastly, enough time should be alloted for a thorough examination.
>
> \- ANONYMOUS

* * *

Movie on LSD

Flight surgeons may be interested in drawing the new movie on LSD and showing it to squadrons, etc. The movie is "LSD," #MN-10507-A, unclassified. CHINFO message R2122592 of December 1967 releases this movie for showing to civilian groups.

* * *

"Navy Medicine Triumphs Again"

We were just getting ready to leave Bermuda on the third leg of an extended flight. The weather was wet and windy and really not a good day for outdoor activity. Suddenly, a man working on a C-130 next to us was observed to fall, apparently knocking himself out. The line crew ran to his assistance and shut down the engines to let the squadron flight surgeon out. (He had accompanied us to observe fatigue on long flights.)

Vehicles converged on the scene approaching at high speed. For a while it looked like to C-130 might get crunched by a crash truck or line vehicle, but all went well. The ambulance slid to a stop and the attendants leaped out, running to the side of the prostrate man. Suddenly, the feet of one of the men went out from under him and he made a tail first landing on top of the injured man. Onlookers helped the attendant up and the injured man was put on the stretcher for the ride to the hospital.

Our flight surgeon climbed back aboard the aircraft shaking his head in wonderment. When asked for a diagnosis, he said in a slow drawl, "Well, the first man had a dislocated shoulder until the second one fell on him and put it back in place." Another triumph of modern medicine!

-LCDR C. A. Gray
VT-29

* * *

Individual Flight Activity Reporting System (IFARS)

This article is being reprinted from WEEKLY SUMMARY (17-23 March 1968) in order to help insure that all flight surgeons are aware of the change from the current Individual Flight Time Report (IFTR):

> The Chief of Naval Operations has directed the Commander, Naval Aviation Safety Center to collect, manage and maintain a data bank of individual flight activity beginning with Fiscal Year 1968 data. On 1 July 1968, a new automated method of reporting flight time will become effective. It will be called the Individual Flight Activity Reporting System (IFARS).
>
> The "new" or replacement reporting procedure will be explained fully in a forthcoming change to OPNAV Instruction 3710.7D, General Aircraft Training and Operating Procedures (NATOPS), paragraph 450. Basically, the flight log yeoman will prepare a data processing card (card type 77) for each naval aviator and naval flight officer from flight information for individuals on each "yellow sheet." The card will go to key punching and a daily print-out will be returned to the reporting custodian of the aircraft for verification. Each ten days the key punched cards will be mailed to the Naval Aviation Safety Center. At the Safety Center the card will be taped and become a part of the IFARS data bank. This information will be recorded under the individual's SERVICE NUMBER instead of by name, so it is essential that all individuals list service number and service branch, i.e., (USN, USNR, USMC, USMCR) on the yellow sheet, Part D. Other-

wise an individual may not receive credit for the flight; the computer will possibly report that individual as not having met annual flight time requirements as well as not having a true total flight time recorded for the aircraft reporting custodian.

Flight time obtained during FY 68 - the year ending on 30 June - will be reported on the current Individual Flight Time Report (IFTR - OPNAV Form 3760-4). This will be the last time this report will be required. The annual rush to corner the squadron's adding machine will be over after this year.

This new system will provide an important exposure index for aviators and will be of great value in studying all aspects of aviation accidents. The system also has prospects for use as a tool in obtaining aeromedical data which will be useful in aviation safety.

It should be noted that the flight surgeon should report flight time as special crew time. Even though he may be acting as co-pilot, his time is recorded as special crew. The only two exceptions would be T-34 time at Saufley and flight time reported by those flight surgeons with dual designations. The new changes should simplify flight time reporting by the flight surgeon.

- Robert D. Wasson
LCDR, MC, USN

* * *

MORs Required

It has been noted that an increasing number of Incident/Ground Accident Reports involving personnel injury or environmental hazards have been received at the Naval Aviation Safety Center without an MOR. Flight surgeons are reminded that in accordance with OpNav 3750.6F, Sec. H, Paragraph 51, an MOR is required in these instances.

* * *

A FLIGHT SURGEON'S EVALUATION OF THE CHANGING TRENDS IN AVIATION SAFETY

Charles I. Barron, M.D., Medical Director
Lockheed-California Company
Burbank, California

I appreciate the invitation to participate in these safety representatives' conferences once again and to share with you my impressions of the changing picture in aviation safety. Having devoted much of the past 25 years to the practice of aviation medicine and being closely associated with the teaching of aviation safety during many of those years, I feel that I am in a most advantageous position to critically review the subject as it pertains to my area of interest in the human factors aspects of safety.

The basic objectives of aviation safety--the achievement of combat readiness with the greatest conservation of manpower and material--haven't changed since World War II, but general ideas and methods for achieving them certainly have. The mobilization and utilization of available resources and talents in a concerted, professional drive to achieve safety have resulted in a most gratifying reduction in the accident rate in both military and commercial aviation. One shudders to think of the horrible consequences had this not been accomplished, especially in this age of ultra-sophisticated and expensive aircraft and highly trained crewmen. Of special interest to me has been the emphasis upon the role of human factors in aviation safety and accident causation and the increasing awareness by command and supervision that herein lies the most potentially rewarding approach to achieving the very ultimate goal of accident-free aviation. Whether or not all available resources have been utilized to their fullest extent and capabilities will be the main theme of my presentation.

The period of 1952 to 1954 was a dismal one for aviation safety in the military services, with accident rates and fatalities reaching their post World War II peak. Many reasons were given for this. The end of the Korean War, with a large turnover of personnel and loss of skilled crewmen and maintenance personnel, and the transition to jet aircraft were listed as primary or contributing causes to the high rates. Stimulated by the needless loss of life and material, intensive programs were undertaken by the military services, and the Navy specifically instituted a number of actions which had an immediate effect in reducing the number of accidents and decreasing the loss of lives. The Safety Center was given top level support in expanding the scope of its activities and in upgrading its capabilities. This included increased emphasis in the human factors area, manifested by improvement in investigation techniques, practical training of flight surgeons and pathologists, intensive education of safety officers, and orientation of command and staff officers in the human factors aspects of accident causation.

One of the most significant steps was the decision to provide professional training for safety officers at the Institute of Aerospace Safety and Management at the University of Southern California. This resulted in the training of approximately one thousand safety officers during the period 1954 to 1965, at which time the training program was transferred to the Navy Graduate School at Monterey, California. The curricula, which underwent continuous review and revision, included instruction in aerodynamics, stress engineering, accident prevention and investigation techniques, and a significant block of instruction in human factors. The course, originally programmed for eight weeks, was subsequently extended to ten weeks and included sixty to seventy hours of instruction in aviation physiology and psychology. This material was presented with the intent of providing safety officers with a better understanding of man's physical, physiological, and psychological capabilities and limitations, and of his reactions and adjustments to the stresses and requirements imposed by exposure to the unique aerospace environment. It was hoped that as a result of this instruction, the safety officers would be more knowledgeable of the role of human factors in accident causation and would be better able to use the flight surgeon and other human factors personnel in accident prevention programs. The potential contributions of the human factors investigation team were explained, and it was expected that this exposure would stimulate the curiosity and the interest of the safety officers in the need for improvement in personal, life support, escape, and survival equipment and procedures. Despite previous exposure to much of the material during physiological training programs the course presented at the school was extremely well received and interpreted in proper perspective to aviation safety. It was definitely shown that this instruction was of considerable benefit to the safety officers by their own comments after they left the school and were able to apply the principles and techniques in actual operation and also by statements from flight surgeons who indicated that the "new breed of safety officers certainly expect more from us in conducting their programs."

Shortly after the start of the safety officers' course, the Safety Center very wisely elected to institute a one-week orientation program for command and staff officers. Eventually, three such programs a year involving seventy-five to ninety senior officers were conducted. The course included a minimum of ten hours in human factors or roughly thirty percent of the curricula. The intent here was to stimulate officers to support the safety effort and the work of the professionally trained safety officers. They were told of the training provided safety officers and of their potential contributions to aviation safety and of their need for command support. The officers were also urged to encourage and support the efforts of their medical officers, especially with respect to accident investigation and autopsy examination. The critiques of the officers revealed almost universal acceptance of the philosophy presented by the staff members, and the reception of the human factors portion of the course was most gratifying. The other military services were so impressed with the value of this short course that they have made arrangements to send their senior officers to similar courses of instruction at the University.

Concomitant with the establishment of a formal training program for safety officers, the Navy School of Aviation Medicine altered its teaching program for flight surgeons to include twenty to thirty hours of instruction in operational aviation medicine and safety. Thanks to the efforts of Captain R. E. Luehrs, budding young flight surgeons were being exposed to the teachings of senior Navy flight surgeons cognizant of the need for medical support in aviation safety. Assisted by the Safety Center and using graduates of the Safety Officers School at U.S.C., the flight surgeons were being informed of their duties and responsibilities in providing much needed support in both accident prevention and investigation. Thus, the cirriculum at the School of Aviation Medicine, acknowledged by all to be outstanding in clinical and research medicine, was now altered somewhat to meet the requirements and needs for operational medical support. A new breed of flight surgeons were being trained to better support the operational requirements of aviation and were being given the tools with which to communicate and relate more effectively with the aviator and his line superiors.

Supplementing the educational efforts were new developments and refinements in the medical aspects of aircraft accident investigation. In 1955 the Joint Committee on Aviation Pathology was established by the Department of Defense, with headquarters at the Armed Forces Institute of Pathology. The committee, whose membership consists of representatives from the AFIP, three American military services, the Royal Air Force, Royal Navy, and Royal Canadian Air Force, was charged with responsibility for all matters relating to the role of pathology as applied to aviation and flight safety and for the dissemination of information on this subject. Specifically, the committee was to collect information regarding the correlation between pathological evidence and causative factors of aircraft accidents; initiate detailed pathological investigations which might yield information relating to cause unknown accidents; improve flight safety records as the result of pathological correlation data; establish a long-range program involving the accumulation of such data; and investigate the psychological and physiological factors which may produce pathological changes as a result of flight stresses. The Joint Committee, which met at periodic intervals, subsequently prepared an autopsy guide for aircraft accident fatalities, with the hope that standardization in autopsy performance could be established thus assuring the acquisition of statistically significant pathological data. As a result of the Committee's activities, the autopsy became a standard and universally accepted procedure in accident investigations. This is quite remarkable considering that in the early 1950's only twenty to thirty percent of all military crewmen who died in accidents were being autopsied. In the last several years, almost one hundred percent of such fatalities have been subject to intensive autopsy and pathological examinations. Since the granting of permission for an autopsy is a command prerogative, it is obvious that line supervision has been properly indoctrinated.

If pathology were to be used as an investigative and research tool to better explore the human factors causes of accidents, trained personnel and facilities had to be available for this purpose. This was accomplished primarily by expanding facilities and services at the Armed Forces Institute

of Pathology and through the designation of strategically located histopathological centers. The AFIP contributed by developing capabilities for performing pathological investigations in the field; the training of military pathologists in forensic pathology; and by the establishment of histological and toxicological laboratories for the performance of exotic and exacting tissue and biochemical tests. The capabilities thus developed became extremely important, not only to the military services, but more recently, to the Federal Government in the investigation of commercial aircraft accidents.

These innovations served to educate the safety officers, medical personnel, and command and staff officers, and to improve techniques used in accident investigation. Other areas of much needed improvement were in the human factors aspect of design and operation of the aircraft and in the protection of the crew members against overbearing environmental stresses. Improvement in aircraft operation and reliability depends to a great degree upon the human factors' inputs during the design and early test phase of a new aircraft. To this end the aircraft manufacturer depends upon inputs from both internal and external (user) sources. Within the aerospace industry, there was a minimum in-house capability in human factors prior to the mid-1950's; and most inputs were provided by so-called "human engineers." When the speaker was first employed as a flight surgeon by the Lockheed Aircraft Corporation in 1950, he was the only physician employed in a full-time capacity as a specialist in aviation medicine in the entire aerospace industry in the United States; and it was not until 1955 that other companies became interested in hiring aeromedically trained human factors personnel. The organizational structure of most companies today will reflect the tremendous change in this situation and the relative importance placed upon human factors in the design and development of aircraft. Most companies have strategically located human factors or life science groups working directly with or supporting the design and engineering efforts. These organizations are well staffed with physicians, psychologists, physiologists, specially trained engineers, and other human factors personnel. The evolution of national and international organizations and the publication of numerous periodicals and articles provide an index of the relative growth and importance of this field. This is not to imply that progress has been easy, but it is certainly my opinion that significant forward steps have been taken and that the future outlook in this area is most encouraging.

In addition to making significant improvements in aircraft and cockpit design and in the development of mechanical and electronic flight and navigational aids, manufacturers have also been extremely active in the development of life support, escape, and survival equipment. While the number of accidents attributed to failure in personal or life support equipment has not been great, the importance of reliability in this area cannot be overemphasized. In many cases, aerospace manufacturers and their suppliers have taken the initiative in conducting the basic and applied research studies necessary to advance and perfect oxygen equipment, helmets and helmet retention devices, pressure suits, escape systems, and survival gear. The importance of assuring a safe escape from a disabled aircraft is self-evident. Air Force studies have shown

that approximately thirty percent of all fatal accidents are so-called "survivable accidents" and of these, 70 percent of the fatalities involve inadequacies of, or improper use of the escape system. This explains the ever increasing emphasis on research and development in escape systems, especially in ejection systems for high-performance aircraft. The aerospace manufacturer is in an ideal position to conduct these studies because of the availability of human factors, engineering, and other allied talents as well as the presence of facilities needed for research and development testing.

The military services through their own research and development laboratories have contributed greatly to these efforts. Much of our basic knowledge concerning man's reaction to physiological stresses and his limitations and capabilities in an aerospace environment have evolved from the studies at the military schools of aviation medicine during the last 15 years, and many of the advances in biotechnology have resulted from efforts at the more advanced military laboratories. One of the most difficult problems in the past has been the inadequacy of communication of vital human factors data between scientists and designers. Admittedly, difficulties still are encountered in communication between pilot and design engineers, but much has been accomplished in recent years by the creation of a climate which encourages direct and free exchange of such information and ideas between the services and the manufacturers. This meeting today and the meetings between the Safety Center and the manufacturers of Navy aircraft are excellent examples of the progress which has been made in communication and in the pooling of talents toward the solution of common problems.

A good example of the extent to which the aerospace industry has gone in the pursuit of safety is that of the Lockheed-California Company in the establishment of an F-104 Safety Committee. The committee was established four years ago in an effort to support the users of this specific aircraft in attaining maximum operational efficiency of the aircraft with the highest degree of safety. Established at the instigation of top management, the committee is headed by a vice president and consists of three subcommittees devoted to aircraft structures, operations, and human factors. The latter subcommittee, chaired by a senior specialist in aerospace medicine, consists of several flight surgeons, a physiologist and psychologist, equipment and indoctrination specialists, maintainability engineer, pilot, pressurization engineer, and representatives from the flight safety and customer service organizations. The subcommittee has reviewed all accident reports; assisted in the identification and classification of possible causative factors; recommended additional studies and modifications in life support and/or life protection equipment; helped to educate Company personnel in accident investigation; prepared articles for inclusion in the safety packets distributed to safety officers of F-104 squadrons throughout the world; and provided a review board for all information pertaining to F-104 human factors' problems. It was most gratifying to hear one senior Air Force pilot state how amazed he was at the extent to which a manufacturer would go in cooperative effort with the users of the aircraft in assuring flight safety.

It would appear from these statements that we are well on the way to perpetuating an ideal system for flight safety; and indeed, when one contracts present attitudes, philosophies, and actions with those existing in aviation safety during and immediately after World War II, the contract is most startling. No longer is safety a dirty word, nor is the flying misfit of the squadron buried in the safety officer's billet. Safety is no longer looked upon as an impediment to the successful training of crewmen or to the achievement of combat readiness. Despite these most favorable trends, the battle for aviation safety is by no means over, not until the ideal goal of accident-free aviation has been achieved. Retention and full utilization of the capabilities of medical personnel have not as yet been achieved. The critical manpower shortage in the medical field will continue to exist in a society in which various segments of the population compete for the services of a limited number of skilled physicians. There is no immediate prospect of alleviating the manpower situation short of extended mandatory retention, which is improbable. It thus appears that the best hope of retaining physicians is to enhance the attractiveness of the service by offering a career in medicine which will be challenging and stimulating to the doctors. This has been accomplished to a degree by offering graduate training in a number of various specialites. A limited number of flight surgeons can today obtain training in the specialty of aerospace medicine leading to full Board certification. Unfortunately, this is a program requiring three years of academic training plus several years of practice, thus limiting the number of available appointments. Since these appointments are generally given to career officers, and because of the existing retention problem, many of the officers are subsequently assigned to administrative or staff positions, limiting their availability and usefulness at the operational level. It has been my observation that it generally requires about five years experience to achieve one's maximum potential as a flight surgeon; and unfortunately, most military flight surgeons are leaving the service at that time. This is reflected in the comments received from many senior officers concerning the loss of flight surgeons "just when they were beginning to really earn their keep."

The flight surgeon's education must constantly be upgraded to meet the needs of an everchanging aviation technology. While the emphasis on operational aviation medicine and safety is increasing in the teaching curricula, it is apparent from conversations with flight surgeons and safety officers that the level of knowledge of recently graduated medical officers in these areas leaves much to be desired. There are other areas in which more intensive instruction is needed--in the pathological aspects of accident investigation and in aviation psychology. Medical officers are not fully cognizant of the importance of pathological procedures in determining the possible causes of an accident; sequencing of events leading to the accident; and in the evaluation of personal, protective, and survival equipment. An almost universal criticism of flight surgeons' efforts by safety officers is the lack of enthusiasm of the physicians for the psycho/sociological aspects of the investigation and for the relatively poor reporting in this area. I am frequently asked why physicians seem to reject this most potentially lucrative avenue of investigation, especially when it is apparent that behavioral and emotional problems are so frequently

involved in accident causation. Also, some psychiatrists believe that by careful personality evaluation and historical review, it is possible to identify those pilots who are most likely to be involved in accidents. Undoubtedly, greater emphasis should be devoted to the teaching of psychology and to the stimulation of the medical officers to search for allied factors which affect pilot performance.

The single most frequent complaint of flight surgeons is their inability to spend a greater portion of their time with their squadrons. Secondary duties, administrative responsibilities, dependents' care, and hospital work frequently conflict and take precedent over their squadron activities. Again, it must be recognized that with limited manpower, other duties must be assigned to flight surgeons. Hospital commanders and senior medical officers must be impressed with the primary responsibilities of the flight surgeon to his crewmen and should be sufficiently motivated to encourage maximum possible participation of the flight surgeon at the squadron level. Another major complaint of flight surgeons is the frustration associated with delays in having their recommendations implemented. It is most discouraging to the conscientious physician to detect what he considers to be a significant fault or defect that can be remedied by a relatively minor change or innovation, but to find his recommendation bogged down in red tape. It is impossible in this climate to stimulate flight surgeons to become more active in human factors research and development. Yet the biggest contributions which can be made by the operational flight surgeon are in the fields of cockpit, environment, and life protection evaluation and redesign.

Safety officers are encouraged to use their flight surgeons in accident prevention programs, at least to the extent that they are used in accident investigation. Safety officers complain that flight surgeons frequently state that they are unable to teach aviation medicine and physiology at the level of understanding of the average aviator. It would certainly seem that inability to communicate with those for whom you are medically responsible would be an intolerable situation for any physician. However, I can understand why some flight surgeons find it difficult to communicate with and motivate pilots. Additional training in communication techniques, preparation of teaching lessons, and in the use of audio/visual aids in presenting instructional material would be most helpful to flight surgeons.

Until recently, it has been difficult to obtain valid statistics concerning the role of human factors' accident causation. This resulted from inadequacies in the medical investigations, lack of standardization in reporting findings, and confusion in terminology. Since preventive measures are predicated on an understanding of causative factors, one wonders why standardization of medical officers' reports was not instituted for all branches of the military services a long time ago, thus making possible long-range predictive interpretations. All too often the assigned causes of accidents were simply the final events or maneuvers preceding the crash and contributed little to an understanding of the mechanisms leading to or influencing the pilot's judgment and decisions. An effort is being made to establish a common MOR, and it is

hoped this will be most productive in providing valid statistics for long-range studies.

It is obvious that the aviation safety picture has changed appreciably in the last two decades and hopefully, will continue to change for the better in the years to come. Weapons systems of the future will be increasingly more complex; and despite all operational and navigational aids, pilots will still have to operate at a maximum level of performance and proficiency. Aviation safety in the future will be even more heavily dependent upon the integrity and reliability of the system design, and this in itself will call for the highest levels of inputs from both industry and the military human factors personnel. Additional studies designed to optimize crewmen's capabilities will continue in the research area. Engineering measures will have to be taken to assure the full protection of the crewmen when the demands of the system or environment threaten human performance or safety. This may result in considerable modification and innovations in cockpit environments and the use of protective equipment. New concepts in escape systems and major technological breakthroughs must occur if we are to exceed our present escape capability of eighty-five to ninety percent.

Finally, more careful thought must be given to the relative merits of tradeoffs in special types of experimental flights where some compromise of comfort and/or risk must be undertaken in order to accomplish an unusual mission. With the recent deveopments in bioinstrumentation and rapid data processing, I look for more practical and extensive use of dynamic in-flight monitoring of crewmen. It is hoped that through the use of biomonitoring, a more accurate and time-related evaluation of a pilot's reaction to his environment can be assessed. Looking beyond this possibility, is the hope that medical research in the space program will lead to a better understanding of early physiological and biochemical changes which may be used as indices or predictors of impending failure. At the present time, our monitoring is limited essentially to gross measurements of major system or organ functions; however, we know that before a system fails, an organ fails, tissues are compromised earlier, and cellular events occur at the very earliest stage. Once baseline indices of normalcy and of impending failure are established, clues as to the imminency of the latter will be identifiable in flight.

With respect to pilots, a better understanding of the factors which contribute to success in aviation as well as to failure must be established; and the Human Error Research and Analysis Program (HERAP) being sponsored by the Safety Center should provide some of the answers. This program, endorsed by the Chief of Naval Operations in August, 1964, was undertaken to ultimately help reduce the human errors which contribute to accidents. The early phases of this program are being implemented, and it is hoped that the accumulation of data embracing man's capabilities with respect to his management of complex weapons systems in unusual environments will be better defined.

In summary, I feel that much has been accomplished in the human factors area to account for the changing picture in aviation safety. I hope that those who are closely associated with this effort continue to pursue what I believe to be the most potentially rewarding aspect of the safety picture.

Presented at the Sixth Aviation Contractors'
Safety Representatives Conference
12-14 March 1968, Norfolk, Virginia

Flight Surgeon's NEWSLETTER

(This material is for the information of commanding officers and Navy flight surgeons and does not necessarily reflect endorsement by the Department of the Navy or the Naval Safety Center.)

FSNL - 3rd Quarter 1968

USN FLIGHT SURGEON'S MANUAL ISSUED

The long-awaited Naval Flight Surgeon's Manual has just been issued; each active duty Navy flight surgeon, aviation physiologist and aviation psychologist will receive a copy. The 871-page, hardback volume was prepared by Bio-Technology, Inc. of Arlington, Va., under contract with the Office of Naval Research. Navy subject-matter experts contributed individual chapters. The manual is published under the auspices of the Chief of Naval Operations and the Bureau of Medicine and Surgery and is available to the general public from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402 at $6 a copy.

Following is the volume's Foreward by CAPT W. M. Snowden, MC, Assistant Chief for Aerospace Medicine:

> "Since the very beginning of the U. S. Navy, the medical profession has played its part. Medical officers have served on every type of ship, beginning with the ALFRED, the vessel on which John Paul Jones hoisted the first American flag in 1775. Initially, medical officers were given no special training but were simply signed on as members of the ship's company for a particular voyage. Indeed, for years no special training was required since the responsibilities of a medical officer aboard ship were essentially no different from those of one treating a civilian population. However, as naval operations became more specialized, the need for unique medical skills became apparent. This has been especially true in naval aviation, where the aviator is subjected to a multitude of unusual stresses. If a Flight Surgeon is to insure the well-being of aviation personnel, he must fully understand the aerospace environment and the physical and psychological problems which may result from operating within this environment. Aerospace medicine has indeed become a specialized medical science.

"This manual represents a continuing effort by the Bureau of Medicine and Surgery to provide the latest information concerning human response to the aerospace environment and to describe the occupational requirements of the Flight Surgeon. Over the years, Flight Surgeons have made a notable contribution to naval aviation and to our general fund of information within the medical sciences. I am pleased to be given the opportunity to dedicate this manual to those who will continue this tradition.

"Without the assistance of Commander Channing L. Ewing, MC, USN, who acted as our Project Officer and Scientific Editor, this manual would not have been possible. He contributed substantially through his efforts during the organization, preparation and review of all materials. A special word of appreciation is due Captain Marvin D. Courtney, MC, USN, who has guided this manual through to its publication."

***

All flight surgeons and Navy physiologists are encouraged to contact the Safety Center for any assistance the Center might be able to provide in the areas of accident investigation and prevention, aviation medicine and physiology and aviation survival equipment. We are also interested in seeing any material -- reprint or original -- which flight surgeons or physiologists think suitable for any of the Safety Center's publications. Let us hear from you. The Center's Aero-Medical Department is located in Building SP-50, NAS Norfolk, Va. 23511. Our Autovon number is 244-3321.

***

CAPT Frank H. Austin, Jr., MC, has relieved CAPT R. E. Luehrs, MC, as head of the Aero-Medical Department of the Naval Safety Center. CAPT Austin has just completed two and a half years of duty as Head of the Aerospace Medicine Flight Safety Branch, Bureau of Medicine and Surgery, and Aeromedical Assistant for Aviation Safety in the Office of the Deputy Chief of Naval Operations (AIR). CAPT Luehrs is reporting to the First Marine Air Wing in Danang, RVN for duty as Staff Medical Officer.

***

ACCELERATION TRAINING PRINCIPLES

By Dr. Randall M. Chambers
Head, Psychology Division
Aerospace Medical Research Department
Naval Air Development Center Johnsville
Warminster, Pa.

Preparing men to fly high-performance aircraft and spacecraft requires an understanding of the basic mechanisms whereby the stresses of flight influence pilot-performance efficiency. One of the stresses of major interest is acceleration such as is encountered by the pilot or astronaut during catapult, dive, pullout, spin, arrest, turbulence, launch, reentry, or egress during flight.

For the past quarter of a century, acceleration research and training have been accomplished not only in aircraft and spacecraft, but also in a large variety of flight simulators. There are, for example, at least 18 human centrifuges throughout the world which have been used for acceleration research and training for pilots of high-performance aircraft. The many research investigations and training programs conducted in these devices have produced much valuable data and information which assist in the understanding of some of the major parameters involved.

Summarized herein are 22 training principles that may be useful to pilots, Aviation Physiological Training Officers, simulator designers, and researchers interested in the effects of acceleration stress on physiological and psychological performance.

PRINCIPLE 1, PHYSIOLOGICAL TOLERANCE: *Physiological tolerance or the ability of the pilot to physiologically withstand acceleration stress, is a function of many acceleration variables and their combinations.* The variables of primary importance are: the direction in which the force is applied, rate of onset, acceleration magnitude, and duration of g. Other factors which also influence acceleration tolerance are: the types of physiological end-points used to determine tolerance, the types of g-protection devices and body restraints used, the body position and posture assumed within the force field, environmental conditions (such as temperature, lighting, pressure suit, and type of breathing air), psychological factors (such as anxiety, fatigue, competitive attitude, and willingness to tolerate discomfort and pain), and previous acceleration experience.

PRINCIPLE 2, PERFORMANCE TOLERANCE LIMITS: *In addition to physiological tolerance limits, which define the end-points for reliable function of any particular physiological system during exposure to acceleration stress, there are also performance tolerance limits which define the end-points for reliable functioning of any particular performance ability system under these same conditions of acceleration.* Physiological and performance tolerance may be functionally related, but need not be of the same magnitude since both are dependent upon the criteria which are accepted. Under conditions of moderate acceleration, experienced pilots use motion and acceleration cues in performing their tasks, and their cues, along with reasonably high concentration and motivation, may enable pilots to do better under moderately high acceleration than under static (1 g) conditions. Under conditions of high gravity, however, performance proficiency deteriorates markedly.

PRINCIPLE 3, PREDICTING PERFORMANCE TOLERANCE FROM PHYSIOLOGICAL TOLERANCE: *Physiological tolerance limits, by necessity, define certain performance tolerance boundaries; however, the prediction of performance tolerances from physiological tolerances is extremely unreliable.* Results of most of the acceleration experiments conducted to date indicate that physiological responses, such as ECG, respiration, blood pressure,

and oxygen saturation level, generally are not reliable predictors of subtle changes in pilot performance.

PRINCIPLE 4, G PROTECTION: *The type of g protection system used has a very important influence on the pilot's ability to tolerate acceleration, perform tasks, and maintain performance proficiency during exposure to acceleration stress.* Human tolerance to the reactive forces that accompany acceleration may be increased or extended in several ways, such as:

(a) Proper body position. Proper positioning involves two distinct component aspects: orientation of the body with respect to the direction of force application, and the body posture assumed within the force field.

(b) Proper body support and restraint. A pilot experiencing the discomfort of either pressure points or the strain of inadequately supported portions of the body cannot perform optimally. The increased weight of the body under acceleration must be distributed evenly over as large an area as possible.

(c) Use of special clothing and equipment.

(d) Breathing of 100 percent oxygen. Positive pressure breathing of 100 percent oxygen has been found to provide some g protection during exposure to high accelerations.

(e) Pharmacological agents. Under certain selected conditions, pharmacological agents may be used to provide additional protection from the effects of acceleration.

PRINCIPLE 5, VISUAL DECREMENT: *Acceleration significantly influences the ability to see.* During the occurrence of all types of high acceleration, the human pilot experiences visual disturbances. These disturbances result from shifts in the availability of arterial blood to the retina; mechanical pressure on the eyes, mechanical forces acting on the eye musculature, eyelids and associated structures; distortions of the eye anatomy; and accumulation of tears.

PRINCIPLE 6, HEARING: *Although the possibility exists that acceleration forces per se influence audition, the ability to hear remains intact after the ability to see fails, and there is some question as to whether hearing actually ceases before or at the time of unconsciousness.* There is some evidence which shows that auditory reaction time increases significantly with exposure to positive acceleration, but the increase in reaction time to auditory signals may result from effects of acceleration on motor response elements involved in the response or from reduced cerebral circulation. No experiments have as yet demonstrated any hearing impairment prior to loss of consciousness. Additional research on the effects of high-acceleration forces on the ability to discriminate sounds at varying loudness levels and pitch ranges must be done before the question of auditory reactions to high-acceleration forces can be answered conclusively.

PRINCIPLE 7, VESTIBULAR REACTIONS: *The vestibular (labyrinthine) sensory system is stimulated by angular accelerations, linear accelerations, and combinations of these.* The reaction of the vestibular system is proportionate to acceleration magnitude but response latencies and habituation may obscure its response. Acceleration stimulation of the vestibular apparatus may produce illusions and disorientation under certain conditions.

PRINCIPLE 8, ILLUSIONS, FALSE PERCEPTIONS, AND MOTION SICKNESS: *Under some conditions, stimulation by acceleration forces can adversely affect orientation, produce illusions and false perceptions, and produce motion sickness.* The illusions and false perception involve vision, bodily position, and motion. There are a large number of illusions and false perceptions associated with kinesthetic, vestibular, and visual senses, as stimulated by both and/or combinations of angular and linear accelerations. These affect the ability to position a limb, to orient one's body, to manipulate tools, and to perform certain tasks. A repetitive change in velocity, i.e., a series of angular accelerations is one of the disruptive features of a continuous motion that frequently produces motion sickness. Motion sickness can be produced by either angular or linear accelerations. When small angular accelerations are

added to a motion that has only linear changes in velocity, its nauseating properties are augmented.

PRINCIPLE 9, ACCELERATION PERCEPTION: *The ability to perceive various types of acceleration and to make estimations regarding the magnitude of acceleration forces is predictable.* Preliminary experimentation shows that sensitivity of the body to changes in gravity varies as a function of the amount of gravitational force being exerted. At a range of 1 to 2 G_z (eyeballs down), a person can sense small changes of 0.1 g and lower. From 2 to 3 G_z, this sensitivity to change decreases to 0.2 g; above 4 G_z, the sensitivity to change is approximately 1 to 2 g; and above 6 G_z, this sensitivity is between 2 and 3 g. Subjects can perceive a reduction from 9 to 6 G_z or from 6 to 4 G_z and they may be aware that considerable residual g remains after both of these reductions. However, a reduction from a high g to a low g may result in failure of the subject to recognize that he is still exposed to accelerative forces in excess of gravity.

PRINCIPLE 10, KINESTHETIC AND PROPRIOCEPTIVE SENSES: *Acceleration forces produce both variations in tension within the body and variations of the pressures in contact with the body.* These forces provide important cues regarding body position, motion, and orientation but they may provide misleading and disorienting cues to the pilot if they are in conflict with vestibular or visual cues that he may be receiving simultaneously. The human subject seems incapable of differentiating the components of a g field to which he is exposed. Research on the extralabyrinthine system has not progressed to the extent that the specific effects of acceleration may be reported precisely, and the technology and procedures that would lend a more quantitative nature to the qualitative descriptions given by subjects during exposure to acceleration are not yet available. Similarly, the degree to which acceleration may act on these senses to influence performance under acceleration, either directly or indirectly, is unknown.

PRINCIPLE 11, TIME PERCEPTION: *Acceleration forces may distort the ability to judge the passage of time, the performance of skills requiring timing of component parts and sequences of complex tasks, the performance of tasks requiring time sharing, and the maintenance of psychological orientation in time.* Most of the data to date suggests a tendency to underestimate the passage of time during exposure to acceleration stress. Variability in response accuracy also increases. However, it has not been possible to obtain conclusive comparative data as a function of all acceleration magnitudes, rates of onset, and directions of acceleration.

PRINCIPLE 12, SPEED, ACCURACY, AND FORCE OF SIMPLE MOTOR MOVEMENTS: *The speed and accuracy of making reaching movements are seriously impaired as g increases.* The amount of force which a person can exert in certain directions changes with acceleration amplitude and with the relative position of the body part and the g vector. The distance and direction through which a pilot is capable of moving parts of his body vary with the position of the pilot's moving member, and with respect to the direction, magnitude, and rate of g onset. Response time for making simple movements varies with the acceleration force, rate of onset, amount of g, type of control, and position of the person within the acceleration field. Generally, response time increases when g increases. Impairment caused by acceleration is greater when the task requires sequential movements. The magnitude and direction of the primary g force have a marked effect on the performance of sequential tasks.

PRINCIPLE 13, COMPLEX PSYCHOMOTOR SKILLS: *Acceleration affects the execution of complex psychomotor skills.* At extremely high g, performance impairment is severe, although at relatively low g, little or no observable impairment occurs. Complex psychomotor skills' proficiency may be impaired during prolonged exposure to linear accelerations, as well as to angular accelerations produced in slowly rotating environments. However, the degree to which this may occur frequently depends partly upon physiological and motivational processes which also may occur during exposure. Highly trained pilots sometimes use acceleration cues to improve their performance during complex mission requirements. During exposure of pilots, astronauts, and volunteers to acceleration tests, rather specific characteristics of piloting performance decrement and error have been recorded.

PRINCIPLE 14, INDIVIDUAL DIFFERENCES: *Major individual differences exist among pilots in their ability to perform psychological tasks at high g.* These differences are due to variations in piloting techniques, methods of fighting g, breathing and straining techniques, and ability to tolerate pain and accommodate to any particular type of restraint system. Susceptibility to motion sickness, and also interest in the performance task, are additional variables which contribute to the pilot's ability to perform during high-g stress.

PRINCIPLE 15, ACCELERATION TRAINING AND PRACTICE EFFECTS: *Major increments in performance proficiency in high-g environments occur as a function of practice.* Practice results in physiological adaptation and conditioning as well as learning proper performance compensations during acceleration disturbances. The pilot improves his performance by: (1) accommodating to the sensations induced by g, (2) learning to resist the effects of g through the use of proper straining and breathing techniques, (3) learning or relearning the task in the context of changed muscular and sensory capacities induced by the acceleration, and (4) learning to execute the physiological maintenance and performance aspects of the task simultaneously.

PRINCIPLE 16, DISPLAY CHARACTERISTICS: *The instrument display characteristic of the piloting task influences performance capabilities during acceleration phases of flights.* A number of the more important display characteristics are: (a) the position of the display instrument with reference to the subject's visual field; (b) the degree of information interpretation which is required of the pilot; (c) the accuracy of the instrument itself when exposed to high g; (d) the overall cockpit configuration; (e) the amount of brightness contrast between the display figure and the background; (f) overall illumination; (g) the physical form in which the display information is presented; and (h) the amount of instrument scanning which is required at high g.

PRINCIPLE 17, CONTROL DEVICES: *The nature of the control device used in performing a task under g has a significant effect upon the limits of performance tolerance.* In acceleration environments, the pilot's performance proficiency varies as a function of the characteristics of the control device that he used in performing his flight task. The operation of controls within a high acceleration field is influenced by the shape of the controls, the control loadings, the position of the controls with respect to the operating body part, control sensitivity, dead band, breakout force, control friction, damping characteristics, control throw, and control response time.

PRINCIPLE 18, FEEDBACK SENSITIVITY: *Acceleration impairs the ability of the pilot to sense changes in control characteristics which may occur as a function of specific acceleration vectors.* There may be direct results of the acceleration forces on the receptors; there may be an effect on the central or autonomic nervous system; or there may be an effect on circulatory and other physiological systems which indirectly affect the ability of the pilot to sense feedback changes in his hand and/or fingers.

PRINCIPLE 19, TASK DIFFICULTY: *Changes in task characteristics which have little effect on performance in low-g environments may seriously impair performance in high-g environments.*

PRINCIPLE 20, HIGHER MENTAL PROCESSES: *Intellectual skills, pilot concentration, time perception, judgment, prediction, immediate memory, and possible other related cognitive processes, may be modified during exposure to high-acceleration stress.* The major portion of available data on these processes is limited to subjective opinion expressed by test pilots and volunteer subjects during experiments in which attempts were made to study possible effects of g on specific intellectual processes. However, quantitative data have been obtained from human centrifuge experiments, supporting the conclusion that higher mental functioning is impaired significantly during exposure to high g.

PRINCIPLE 21, EMOTIONAL PROCESSES: *Emotional reactions resulting from anticipation of the effects of acceleration and fear and anxiety during high-g stress may produce physiological and performance disturbances that may be more disruptive than the direct physical effects of the acceleration forces themselves.*

PRINCIPLE 22, EFFECTS OF COMBINED STRESSES: *If, in addition to acceleration stress, the pilot is exposed to other stresses, his response may result from the combined effects of these stresses and/or the interactions among them.*

SUMMARY

An attempt has been made to formulate 22 acceleration training principles that summarize existing life-science data pertinent to pilot-performance capabilities and limitations within high-g acceleration environments. These principles may be of interest and assistance to training officers concerned with the planning and conduct of acceleration training and conditioning programs for pilots and other aircrew members, and to project engineers concerned with the development and utilization of flight simulators, human centrifuges, and other acceleration testing and simulation devices. As systems used in manned flight become more complex, the requirements for precise and comprehensive acceleration training also increase. These arise from the need to provide the occupants of aircraft and spacecraft with the ability to maintain reliable physiological and psychological performance during all phases of flight.

NAVAL AIR SYSTEMS NEWS, Vol. 1, No. 4

***

FOODBORNE GROUP A STREPTOCOCCAL EPIDEMIC

The following article is reprinted from the National Communicable Disease Center's Morbidity and Mortality Report for the week ending 25 May 1968, Vol. 17, No. 21. An epidemic such as the one described, which took place at the Air Force Academy, could easily occur aboard ship.

An epidemic of Group A streptococcal pharyngitis occurred among the cadets at the U.S. Air Force Academy from April 27 through April 30 (Figure 1). Approximately 600 cadets with severe prostrating illness characterized by high fever, headache, and sore throat were seen in the academy hospital clinic on Sunday, April 28; 89 cadets required hospitalization. Of the 89 hospitalized cadets, 90 percent had exudative pharyngitis and tender cervical lymphadenopathy, and 91 percent on throat culture yielded a Group A, M non-typable, T-12 streptococcus. Of 418 cultures taken on April 28, 224 cultures (54 percent) were reported as presumptive B-hemolytic streptococci by the Air Force Academy Hospital Laboratory; 139 of these cultures were grouped and typed, and 124 cultures (89 percent) were of the epidemic strain. A random selection of 100 well cadets, cultured at the time that mass prophylaxis was given on April 30, demonstrated an epidemic strain prevalence of only 2 percent.

Following initial fluorescent antibody examination which indicated that the etiologic agent was a Group A streptococcus, control measures were instituted. Cadet classes and dependent and public schools in the area were suspended from April 29 to May 1. On Tuesday, April 30, mass prophylaxis utilizing 1.2 million units of benzathine pencillin G or oral erythromycin was given to approximately 2,200 cadets who had not previously been treated. Members of the hospital staff and food handlers were cultured and treated if the cultures were positive. Following mass prophylaxis on April 30, a marked reduction was noted in clinic visits for pharyngitis (Figure 1).

The overall attack rate in the cadet population of 3,012 was 27.5 percent. Squadron attack rates failed to reveal any significant difference between individual squadrons.

Because of the explosive nature of this epidemic, a common source foodborne outbreak was suspected. Several factors tended to localize the time of exposure to the noon meal on Friday, April 26. The incubation period of 12-72 hours coincides with the incubation periods described in previous foodborne outbreaks of streptococcal pharyngitis.[1,2,3,4] A flight training class of 58 cadets who did not eat the noon meal on Friday reported no cases of illness with onset before 6 p.m. Monday, April 29. From this group, five cadets subsequently became ill and probably represent secondary respiratory spread. From a group of 26 persons who ate only the noon meal on Friday with the cadets, 6 persons became ill with symptoms of streptococcal pharyngitis during the following 48 hours.

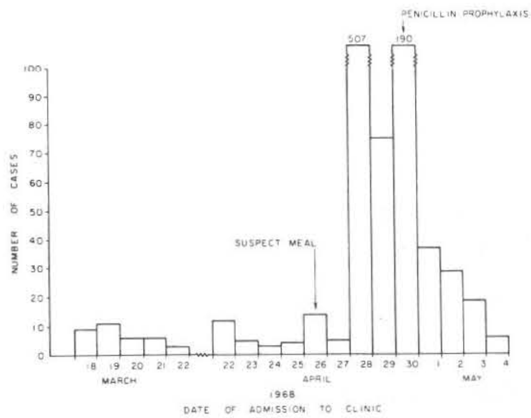
Cultures from all food items served at meals from Friday evening through Sunday failed to yield Group A streptococci. Milk and milk products from the same lot as that served on Friday and Saturday were also negative. Portions of the prepared food items served at the noon meal on Friday were not available for culture.

An analysis of food histories obtained from both hospitalized and well cadets pointed to the tuna salad at the Friday noon meal as the responsible food. An investigation of the preparation of the tuna salad revealed that the hard boiled eggs used in the salad had been steamed and sliced on Thursday, April 25. The sliced eggs were then placed in large pans and left overnight at 58°F. The salad was then prepared at 6 a.m., April 26, and stored immediately at 38°F. until served at the noon meal. The suggestion that eggs were the vehicle of infection is consistent with other reports of foodborne streptococcal epidemics that incriminate eggs as the vehicle of transmission.[1,2,3,4]

On April 28 and 29, 229 food handlers in the mess hall were cultured. Six were positive for Group A streptococci, three of which were T-12, the epidemic strain. Histories, physical examinations, throat cultures, and blood specimens obtained from food handlers who assisted in preparing the tuna salad, to date, have failed to incriminate definitely a single source of the inoculum.

Intensive surveillance for cases of nonsuppurative sequelae has failed to reveal such complications.

Figure 1
PHARYNGITIS IN CADETS
AIR FORCE ACADEMY OUTPATIENT CLINIC
MARCH 18-22, APRIL 22-MAY 4, 1968



(Reported by Major Roger Kilton, USAF, Laboratory Officer, U.S. Air Force Academy Hospital Laboratory, Colorado Springs, Colorado; Cecil S. Mollohan, M.D., M.P.H., Chief, Section of Epidemiology, Colorado State Department of Public Health; Streptococcal Disease Section, Ecological Investigations Program, NCDC, Kansas City, Kansas; and two EIS Officers.)

References:

[1]U.S. Commission on Acute Respiratory Diseases, Fort Bragg, N.C.: A study of a foodborne epidemic of tonsillitis and pharyngitis due to beta hemolytic streptococcus, type 5. Bull Johns Hopkins Hosp *77:*143-210, 1945.

[2]U.S. National Office of Vital Statistics: Morbidity and Mortality Weekly Report, Vol. 4, No. 32, Aug. 19, 1955.

[3]U.S. National Office of Vital Statistics: Morbidity and Mortality Weekly Report, Vol. 5, No. 4, Feb. 3, 1956.

[4]Farber, R. E. and F. A. Korff. Foodborne epidemic of Group A beta hemolytic streptococcus. Public Health Reports *73:*203-209, 1958.

MEDICO-LEGAL EVALUATION OF BLOOD-ALCOHOL LEVELS

(The following reprint from the Virginia Medical Monthly, Vol. 80, pages 638-639, November 1953, was issued by the Office of the Chief Medical Examiner, Department of Health, Commonwealth of Virginia, as a "Medico-Legal Note." The original article was contributed by Sidney Kaye, B.S., M.Sc., Toxicologist, Office of the Chief Medical Examiner, and Harvey B. Haag, M.D., Professor of Pharmacology, Medical College of Virginia. It is presented here for the information only.)

The following information is presented with the hope that it will be useful when questions arise pertaining to the relationship between blood-alcohol values and the condition referred to as "being under the influence," especially as related to ability to operate motor vehicles safely.

1. Actions:

Ethyl alcohol is basically a central nervous system depressant, acting in a manner similar to that of the general anesthetics such as ether and chloroform.

2. Absorption:

Alcohol requires no digestion, and absorption occurs apparently by simple diffusion from the stomach and intestines into the blood stream. This diffusion is so rapid that from 80-90 percent of the ingested quantity may be absorbed in about 30 minutes although complete absorption requires approximately 2 hours. Of the order of 20 percent is absorbed from the stomach and the remainder from the small intestine. A delay in gastric emptying time is a most important factor in slowing the rate of absorption. Largely because of this, speed of absorption may vary between individuals and in the same individual at different times. Ordinarily the most important factor in delaying absorption is the presence of food, carbohydrates and proteins being equally or possibly more effective than fats in this respect. The concentration and nature of the alcoholic beverage are also influencing factors; for instance, the alcohol in beer is more slowly absorbed than that in an equal concentration in water.

3. Fate:

Approximately 90 percent of the alcohol absorbed is completely oxidized to CO_2 and water. The initial stage of this metabolism begins in the liver, hence the possible effect of liver disease on the intensity of the alcohol activity. The remaining 10 percent is eliminated unchanged chiefly by the lungs and kidneys. Normally the

body destroys and eliminates alcohol at a rate equivalent to 2/3 oz. of whisky per hour. In terms of changes in the blood-alcohol percentage, this corresponds to a decrease of approximately 0.02 percent per hour.

4. Individual Tolerance:

This depends upon congenital or acquired tissue (brain) susceptibility, rate of absorption, rate of elimination, age, and the general medical condition of the subject. Individuals in ill health, mentally or physically, are usually more profoundly affected by alcohol than those in a state of good health.

5. Usual Methods of Testing:

Direct determination of the concentration of alcohol in the blood by chemical analysis is the most reliable practical method. Indirectly, blood-alcohol levels may be reasonably well determined by analysis of the expired air for alcohol.

6. Synergisms:

Subjects taking depressant drugs such as the barbiturates, morphine and chloral hydrate concomitantly with alcohol will be more markedly affected than otherwise. Such drugs should be used with special care in the presence of alcohol.

7. Signs and Symptoms:

Alcohol brings about a release from the usual restraints and inhibitions. As a result there is the appearance, initially at least, of stimulation. Actually, this is a pseudo-type of stimulation. Depending on the amount taken, there is a sense of security, feeling of being a "superman," a nothing-matters-plenty-of-time attitude, hilariousness and boisterousness. Judgement, reflexes, vision, mental efficiency and muscle coordination suffer. There is analgesia, mental confusion, slow and sluggish thinking, decreased efficiency in responding to emergency situations and inability to perform simple tasks with equal speed and accuracy.

8. Interpretation of Blood-Alcohol Values (largely from National Safety Council Memo No. 29):

Less than 0.05 percent = prima facie evidence that the subject is not under the influence of alcohol.

0.05 percent-0.15 percent = corroborative evidence to be considered with outward physical symptoms. In general, the nearer the level of 0.15 percent is approached, the more likely the subject is of being under the influence of alcohol.

0.15 percent and above = prima facie evidence that the subject is under the influence of alcohol insofar as the operation of a motor vehicle is concerned.

0.25 percent and above = the subject is markedly intoxicated.

0.40 percent and above = comatose levels of alcohol which may lead to death.

9. Approximation of Alcoholic Beverages to Reach Given Blood-Level:

A 12-oz. bottle of beer (4 percent) contains approximately the same alcohol content as 1 oz. of whisky (100 proof). For an average 160 pound individual* tested within 30-45 minutes after drinking; a minimum of:

2 oz. whisky = 0.05 percent alcohol in blood.

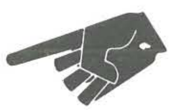
4 oz. whisky = 0.10 percent alcohol in blood.

6 oz. whisky = 0.15 percent alcohol in blood.

8 oz. (1/2 pint) = 0.20 percent alcohol in blood.

*Other things being equal the greater the body weight, the larger (in rough proportion) must be the alcohol intake to achieve an equal alcohol value.

EFFECTIVE DATE OF NEW MOR



It is anticipated that the new Tri-Service Medical Officers' Report forms will be available at the stocking points by 1 August 1968. Do not use these new forms until you receive Change 2 to OPNAVINST 3750.6F. This change will contain complete instructions for use of the new form.

BLOOD-ALCO CHART WALLET CARD

Dr. Stanley R. Mohler of FAA passed us a copy of the following wallet card, courtesy of the Illinois Department of Aeronautics. The "Blood-Alco Chart" serves as an excellent guide for determination of time required for oxidation of ingested alcohol. However, as we all know too well, this isn't the whole story. Don't forget the hangover.

BLOOD-ALCO CHART

SHOWING ESTIMATED % OF ALCOHOL IN THE BLOOD BY NUMBER OF DRINKS IN RELATION TO BODY WEIGHT

BODY WEIGHT / DRINKS	1	2	3	4	5	6	7	8	9	10	11	12
100 lb.	.038	.075	.113	.150	.188	.225	.263	.300	.338	.375	.413	.450
120 lb.	.031	.063	.094	.125	.156	.188	.219	.250	.281	.313	.344	.375
140 lb.	.027	.054	.080	.107	.134	.161	.188	.214	.241	.268	.295	.321
160 lb.	.023	.047	.070	.094	.117	.141	.164	.188	.211	.234	.258	.281
180 lb.	.021	.042	.063	.083	.104	.125	.146	.167	.188	.208	.229	.250
200 lb.	.019	.038	.056	.075	.094	.113	.131	.150	.169	.188	.206	.225
220 lb.	.017	.034	.051	.068	.085	.102	.119	.136	.153	.170	.188	.205
240 lb.	.016	.031	.047	.063	.078	.094	.109	.125	.141	.156	.172	.188

SEE INSTRUCTIONS ON REVERSE SIDE

Hrs. since 1st drink..	1	2	3	4	5	6
SUBTRACT........	.015%	.030%	.045%	.060%	.075%	.090%

THE REMAINDER IS AN ESTIMATE OF THE % OF ALCOHOL IN YOUR BLOOD.

Example – 160 lb. man, 8 drinks in 6 hours
.188% minus .090% = .098%

INTERPRETATION OF RESULTS

% of Blood-Alcohol	Intoxicated?	If You Are a Pilot
.001 to .050	You Are Not	Don't Fly
.050 to .100	You May Be	Don't Fly
.100 to .150	You Probably Are	Don't Fly
.150 and Above	YOU ARE	Don't Fly

COURTESY – ILLINOIS DEPARTMENT OF AERONAUTICS

Flight Surgeon's NEWSLETTER

(This material is for the information of commanding officers, aerospace physiologists and psychologists and Navy flight surgeons and does not necessarily reflect endorsement by the Department of the Navy or the Naval Safety Center.)

FSNL - 4th Quarter 1968

THE DILEMMA OF THE MEDICAL OFFICER'S REPORT OF AIRCRAFT ACCIDENT AND THE "MATERIEL ONLY" ACCIDENT

Throughout the history of the aircraft accident prevention and investigation programs a hue and cry from safety officers and flight surgeons has been raised recurrently against apparently excessive requirements for submission of the MOR in aircraft accidents. This has been particularly intense when a so-called "materiel only or maintenance only" accident has occurred and there has been no visible evidence of what might generally be termed aeromedical factors (including equipment, survival and rescue).

There are principally two vital areas concerning this problem. First, an active and effective accident prevention and investigation program must include intimate and continuing participation by the flight surgeon. This has been assumed by requesting submission of the MOR. Second, in order to perform its mission, the Safety Center has need for a continuing input of certain base line aeromedical data. This information is essential for the development of valid statistical correlations concerning the aeromedical factors. The only manner in which this data can be readily obtained at present is through the vehicle of the MOR.

It is obvious from the above discussion that an ultimate truly valid statistical correlation of aeromedical factors in accidents and non-accidents would necessarily include a study of these factors in a normal, operational, non-accident environment. As a matter of fact, attempts are underway at the present time to develop methods of acquiring this non-accident and exposure data in a manner which will throw as little burden as possible upon the operators. It is desired that this data be amenable to automatic data processing methods for storage, retrieval and analysis. There is still a great deal of work to be done in this area.

However, apropos to the problem of reducing the workload for the flight surgeon, and still maintaining an effective aeromedical safety program, the Naval Safety Center now has under intensive study an abbreviated MOR form. The criteria for the use of such a form must include a critical review of the accident or incident by the flight surgeon in order that he may assure the commanding officer that, in fact, no aeromedical factors exist. Secondly the requirement for submission of certain aeromedical data, which although it is recognized may not be relevant to a particular accident, must be continued for the reasons previously mentioned.

Parenthetically it may be stated that if the safety officer and the flight surgeon dig deeply enough in any accident, no matter how "maintenance only" it may appear, it is probable that some human factor will become evident. We want to get such information and believe if we do, some greater inroad can be made into the field of the prevention of human error accidents.

Until the abbreviated MOR is approved and distributed, and this may not be soon, since tri-service consideration and a great deal of other detailed work are necessary, the requirements for the MOR as listed in OPNAV Instruction 3750.6F, will remain unchanged. Note that not all pages or parts need be submitted on each accident. Just be consoled to know that all the effort which goes into MOR preparation is appreciated by all concerned and significant contributions to naval aviation safety are being realized because of it.

-Frank H. Austin, Jr.
Captain, MC, USN

* * *

NOTES FROM MEDIBONE

Change 2 to OPNAVINST 3750.6F 26 July 1968 is in the field as are the new MOR forms - OPNAV Form 3750/8 series (Rev. 4-68). Be prepared. Order the new forms now and be ready. As noted in the Instruction, all forms are available from cognizant symbol "I" stock points and may be requisitioned in accordance with S&A Publication 2002. Ask your supply type, don't ask us except in real emergency. We have to order them too.

We welcome your questions though, and will do our best to clear up any discrepancies. We will have lots more about the new MOR in future issues.

* * *

The new Tri-Service MOR includes a section for reporting Aviator Aerospace Physiology Training. This particular section enables the Safety Center to stay abreast of the effects which such training provides during emergency situations. To better facilitate this, five separate types of training can be coded by the Center from the report. However, the form (OPNAV 3750/8D) asks only for the general Physiological, Low Pressure, and Vertigo training. Flight Surgeons should indicate in this section one or all of the following five types of training under "Type Training Accomplished" as applicable:

Low Pressure Chamber Run
Visual Problems (Lecture and/or Movies)
Flash Blindness (Lecture and Trainer)
Vertigo (Demonstration and/or Trainer)
Night Vision (Demonstration and/or Lecture)

Ejection Seat Training is recorded on Section 12 of OPNAV Form 3750/8F and Survival Training on Section 1 of OPNAV Form 3750/8H.

* * *

EJECTION IN MK-4 FULL PRESSURE SUIT FROM F-4J

The following material is excerpted with permission from McDonnell-Douglas Aircraft Accident Investigation Report G195 of 20 March 1968:

"At 0932 Central Standard Time on 20 March 1968, F-4J BuNo 155557 (McDonnell No. 2833) crashed at the Lambert St. Louis Municipal Airport, St. Louis, Mo. The pilot was performing an afterburner takeoff from Runway 24, when he discovered that he could not move the control stick forward to reduce the pitch attitude. The pilot and radar operator ejected successfully, using the Martin-Baker H-7 ejection seat... It is concluded that this accident resulted from blockage of the manual flight control linkage to the stabilator actuator. The source was not positively identified...

"On the basis of motion pictures taken of other F-4 takeoffs immediately preceding the accident, the attitude of BuNo 155557 at lift-off was estimated at approximately 14 degrees, aircraft nose up. Pitch-up commenced immediately after lift-off, with a notable change in rate as the aircraft left ground effect. The approximate peak attitude reached was 85 degrees, with impact estimated at 45 degrees (right stabilator tip first). Peak altitudes were estimated using the impact times of the pilot's seat and canopy, assuming free fall of these items at 32.2 feet per second^2.

"Egress Sequence: The plotting of ejection and subsequent seat trajectories was not performed. However, the film does indicate that the radar observer departed the aircraft relatively perpendicular to the pitch axis and continued on this course until leaving the field of view. The radar observer tumbled a half turn prior to drogue deployment which occurred while the seat was traversing upside down (i.e.,radar observer feet first). The pilot ejected and made a quarter turn (body almost parallel to the aircraft pitch axis) at the second rocket sequence. He continued in this manner until reaching peak altitude, at which point the drogue chute deployed, followed by a very slight seat oscillation and normal parachute deployment...

"Aircrew Physical Condition: Both aircrew members were examined by a McDonnell-Douglas flight surgeon immediately after the ejection. The pilot reported mild neck soreness with no radiation. Other than this, neither crew member complained of any injury. Physical examination and complete spinal x-rays disclosed no indication of traumatic injury in either man. The pilot reported that he had slept approximately nine hours on the night of 19/20 March and was in excellent health...

"Pilot's Statement: '...After no response or relief from the paddle switch, and noting that the aircraft was about 30° nose up, I shouted eject to the RO and pulled the lower eject handle. Very shortly thereafter, I heard the RO's seat fire and my seat kicked off about a second later.

"I didn't see much during the rocket ride, but when the G's relaxed, I saw the aircraft descend from about 75 feet to the ground. My seat separated okay and fell away and I felt the chute open. I had just enough time to reach the chute risers before hitting the ground, moving face first. After hitting the ground I unfastened the parachute and got my face shield up, then ran over to check on the RO.'

"Radar Observer's Statement: '...We started takeoff roll, gained airspeed and, just after getting airborne, left wing dropped about 30 degrees and the pilot brought it back up and the nose continued to rise abnormally. At approximately 30 to 40^{o} nose up, I pulled the alternate handle. Heard the seat fire, was conscious of clearing the aircraft and the seat falling away. After the main chute deployed, tried to see if I could see aircraft falling. Did manage to turn enough to see it falling in a flat attitude, gear down--did not see ground impact. Felt a very small pain in my right ankle as I hit the ground. My chute billowed so I released shoulder fittings and seat pack fittings.'"

9.0 APPENDIX I

"9.1 Summary of Egress System Operation

"9.1.1 Aircrew Personal Equipment

(a) Aircrew Height and Weight

Pilot:	6 feet 0 inches; 188 pounds
Radar Observer:	5 feet 6 inches; 140 pounds

(b) MK-4 Mod III Full Pressure Suit
(c) Standard "Safety Toe" Flying Boots (USN Type)
(d) MA2/P Integrated Harness
(e) Ejection Seat: Martin-Baker Type H-7, with Seat Sequencing System
Pilot: S/N 113-82
Radar Observer: S/N 116-85
(f) Survival Kit: Rocket Jet RSSK-1A
Pilot: S/N 232
Radar Observer: S/N 199
(g) Parachute: Skysail "E"
Pilot: S/N 70688-89
Radar Observer: S/N 70688-716

"9.1.2 Martin-Baker Type H-7 Ejection Seat - The ejection seat sequence was initiated at an altitude of approximately 70 feet by the radar observer, and at approximately 300 feet by the pilot. Both seats were in the full-down position. There is some degree of doubt as to whether the radar observer or the Seat Sequencing System initiated the radar observer's ejection; however the time interval of 1.1 seconds (instead of the nominal .45 seconds) between his ejection and the initial movement of the pilot's canopy, indicates that the radar observer initiated his own ejection before the system was actuated by the pilot. Both the manual ejection and sequence

ejection actuate the same rod and cable assemblies.

"Both systems functioned normally and in correct sequence, with the aft canopy leaving the cockpit, followed by the seat catapult firing and rocket pack ignition. Drogue gun firing and drogue parachute deployment occured in normal sequence, with the drogue parachute pulling the skysail personal parachute from its container. Normal parachute deployment was attained, although a burn hole and what appeared to be a metal fleck from the rocket pack were found on Gore 13, Panel Two of the radar observer's parachute. The burn did not occur upon ground impact, since the seat landed 100 feet forward of the radar observer's ground impact and no dragging of the crewman was reported. The metallic deposits on the parachute were subsequently identified by laboratory analysis as cadmium. This is the material that plates the rocket tubes. Swipe marks are present on the Number 5 and Number 6 rocket tubes. Motion picture coverage did not show the radar observer after the drogue gun firing and eyewitness accounts reported no severe gyrations by the crewman during or after the ejection. Accordingly, it is not possible to determine exactly how the parachute was burned. The radar operator's right shoe struck an unidentified object during the ejection sequence, causing a two-inch cut on the inside toe area and another along the right row of shoelace eyelets. The radar observer, not having sufficient time to deploy his survival kit, landed with the kit still attached to his harness. His impact area was soft, grassy turf.

"The pilot's egress system functioned in normal sequence, with initiation of the system by the alternate D-ring. Normal canopy separation took place, followed by cartridge firing through the sequence actuators and rocket ignition. Drogue gun firing and drogue parachute opening occured and was followed by inflation of the personal parachute canopy. The pilot did not deploy his survival kit and landed in soft, grassy turf with the kit attached to his harness.

"9.1.3 Egress System Timing - The following data were collected from two motion picture camera sources and correlated with the flashing anti-collision beacon on the vertical fin. The beacon frequently is assumed to be 80 cycles per minute.

Ejection Sequence	Elapsed Time	Normal Timing Sequencing System
Aircraft Lift-Off	0.0	-
Aft Canopy Ejects	2.73	0.0
Radar Observer Ejects	2.88	0.30
Forward Canopy Ejects	3.96	0.45
Pilot Ejects	4.26	0.40
Total Time	1.53 seconds	1.15 seconds
Aft Seat Rocket Burn Time	0.27	Nominal 0.25 seconds
Forward Seat Rocket Burn Time	0.27	Nominal 0.25 seconds"

* * *

TWO MEN LOSE CONSCIOUSNESS IN FUEL CELL FROM INHALATION OF JP-5 VAPORS

(The following incident is described here in some detail for possible use by flight surgeons in their squadron safety program.)

The aircraft in question, an EKA-3B, was last flown prior to the mishap from carrier to naval air station. At both enroute fuel stops, at Air Force bases, the aircraft was fueled with JP-4 instead of JP-5 since JP-5 was not available. On the morning of the mishap the aircraft was defueled and the top hatch of the aft fuel cell was opened in preparation for incorporation of an Aircraft Service Change in which the Christmas tree of float switches in the aft tank was to be replaced by a modified part. Due to supply delay the job was left for night check to perform.

The AE1 assigned an AA to remove the old "Christmas tree" and replace it with a new one, a job he had done once before. The AE1 told him to find another man from the shop to work with him and the AA selected an AN who was also a close friend. The AE1 briefed the two men on what they were to do but did not specifically brief them on safety procedures.

When the AA found the air hose available would not reach from the outlet to the fuel tank he decided to do the job without a mask. The AE1, however, crawled inside the tank to inspect the job to be done, then told the men they could not work in the tank without a mask. It did not at that time occur to the AE1 that the fumes were stronger than usual but later he stated that in retrospect they were considerably stronger than in other similar jobs.

The AA then connected an air regulator and rubber full face mask to the hangar's low pressure air supply. He had to borrow an extra length of hose to reach the aircraft where it was spotted. With the AN on top of the aircraft, he entered the aft tank and removed the old "Christmas tree" and came back out. This took about 20 minutes. Next the two men went to dinner, then made two trips both on foot, at a leisurely pace, to pick up the new "Christmas tree" and return the old one. After checking with the AE1 on how to break down the new part to get it into the aft fuel cell, the two men went back to the aircraft. The AA donned the mask and went into the tank with the new part. The AN was on top just outside the entrance. Both men had removed all metal objects from their persons except for their tools.

When the AA found he could not simultaneously hold the new part in place, hold his flashlight and tighten the nut, he asked the AN to come into the tank to help him. The two men intended to share the air mask. The AE1 who was walking across the hangar at this time saw the AN disappear into the tank so went to the aircraft, climbed up on it and asked if everything was all right. Both men replied in the affirmative. The AE1 told them that only one man was supposed to be in the tank at a time. The AA replied they were coming right out. The AE1 then left, erroneously assuming the job was finished.

The AN and AA planned to climb out of the fuel cell for some air after which the AA intended to go back in and fasten the Adell clamps. The AN was wearing the mask when both men turned to leave the tank. He removed the mask, held it in his left hand and climbed up on the hump in the aft tank over the main gear well. He then looked back to see if the AA was following and saw the AA laughing and behaving in an erratic manner. The AN tried to help him out of the cell but was unable to do so because the AA's foot was caught. Both men then passed out from the fumes, the AN collapsing face down on the top of the hump in the tank and the AA lying on his side in the bottom where there was about an inch of residual JP-4.

The investigating flight surgeon pointed out that once the AN had entered the fuel cell and mask sharing began, both individuals' sense of smell was probably paralyzed. As the recognition of the continued presence of fumes was lost they probably became less attentive to their mask sharing. The AA's giddy behavior observed by the AN as they began to exit the cell indicates the degree of effect in a short period of time. This was shortly followed by loss of consciousness.

An AMEC, the night check CPO, passed the aircraft while making an inspection round. Stopping at the shop where the AE1 was still working, he mentioned that he had not seen anyone on top of the aircraft and asked if the men were still working on it. The AE1 immediately remembered the events of 45 minutes before and that he had not seen the AA and AN since. Running to the top of the aircraft he located the AN on the upper level near the entrance to the tank. Shouting for assistance, the AE1 went into the cell and pulled the AN nearer the exit port. He then handed him to the men outside the cell who pulled him out. The AE1 then exited the cell, dizzy from exertion and inhalation of fumes, but told two men who had just arrived that there was another man still inside.

One of the men entered the cell and found the AA lying on his side with his face in some fuel and his arms held stiffly at his side. He turned him face up but could not move him. With the assistance of a second man he was able to get the AA to the upper level and up onto the hump before they too had to exit the tank due to dizziness and fume inhalation. A second AMEC who had been giving oxygen to the AN from a cockpit cylinder then lowered himself into the cell and positioned the AA's arms under the hatch so that he could be dragged out by outside personnel.

By this time the first AMEC had run to the duty office and phoned for an ambulance. Returning to the aircraft, he saw the AN was dazed but moving and breathing. The AA, however, was not breathing. His lips, nose and ears were cyanotic and his pulse was very weak and erratic. Both the AN and AA were stretched out on the aircraft's wings. The AMEC applied mouth-to-mouth resuscitation to the AA until relieved by a corpsman 10 minutes later when the ambulance arrived. Fortunately, both men survived, but the AA suffered through a long hospitalization period.

Both men sustained first and second degree chemical burns from saturation of clothing and resultant skin contact with the irritating components of petroleum products as well as the contained additives which are corrosion and oxidation inhibitors such as amines and phenols. The investigating flight surgeon attributed the difference in the degree of shock between the AN and the AA to the fact that the AN collapsed beneath the fuel cell opening on top of the mask. Thus the air line continued to supply a certain degree of air to this area of the fuel cell and vapor concentration would be less, he said. The AN was admitted to the base dispensary and the AA was hospitalized for his burns and observation for chemical pneumonitis secondary to inhalation of petroleum. Both men subsequently returned to duty.

Investigators had this to say about the incident's cause factors:

"The primary cause of this mishap is maintenance personnel error in that stated safety precautions were not followed. Had the AE1 not directed him otherwise, the AA would have at least started the job with neither an outside observer nor an air mask. He did not wear a safety line; however it must be conceded that such a line is of questionable value when working in an A-3 fuel tank since an unconscious man cannot be hauled out from the outside using such a line. The AA further reduced his safety margin by asking the AN to come into the tank with him, especially since there was only one air mask between them.

"Maintenance supervisory error is a contributing cause of this mishap. BUWEPSINST 10345.1A concerns the preparation for repair, modification and cleaning of aircraft fuel tanks and states that '...the individual entering must wear a full face piece, air-supplying respirator and safety line. A second workman provided with a supplied air respirator will remain outside the cell...' It is considered that neither the AA nor the AN was ever impressed with the importance of these safety procedures prior to entering the cell or in their previous training. Another contributing supervisory factor is that no squadron procedures exist to alert maintenance personnel whenever an aircraft is fueled with other than JP-5."

Among investigators' recommendations was that "Industrial safety regulations, especially those concerning the more dangerous squadron jobs such as LOX handling, working with high voltages, inflating tires and handling fuels and other aromatic hydrocarbons be emphasized to a greater degree and with more regularity. Along with such emphasis, all hands must continually be exhorted to use common sense and mature judgment in performing their jobs."

Investigators also recommended a mandatory yellow sheet entry whenever an aircraft is fueled with JP-4 instead of JP-5 and that the maintenance department develop procedures to alert all hands who work on such an aircraft until all cells of that aircraft are rendered safe in accordance with JP-5 standards.

Endorsers to the final report reemphasized that although the dangers in handling JP-5 are less than in handling JP-4 or AvGas, the toxic effects, the inherent explosive danger and the requirement for stringent safety precautions still exist and all pertinent regulations must be rigidly adhered to at all times.

Comments by NAVSAFECEN Industrial Hygienist:

Sound industrial health and safety practice for work in a closed space, such as this situation, requires, for example, the following considerations:

1. The space should be drained of fuel, followed by purging the space of residual volatile liquid and vapors. This requires several hours of mechanical ventilation, exhausting the vapors through exhaust hose to a safe outdoor area.

2. The space should then be checked (from the outside) initially to see that it is "gas-free" by use of explosive and volatile toxic gas meters, and by use of an oxygen testing device (for sufficiency of oxygen). After "gas-free" certification, and with continued ventilation, entry can then be made without the need for respiratory protection and work can proceed in comfort.

3. For emergency entry situations, when it must be assumed that concentrations of toxic vapors immediately hazardous to life exist in the space (as in this situation), the proper respiratory equipment consists of self-contained breathing apparatus ("fire-fighting" air or oxygen breathing apparatus (OBA)), or hose mask with blower (normally not available to naval installations). The use of air line respirators (type C) in situations where vapor concentrations may be immediately hazardous to life is not permissible according to Bureau of Mines (respirator regulatory agency) regulations. If the airline were crimped or cut, the individual could be in a disastrous situation. Its use could probably be justified if exhaust ventilation were also present to reduce the vapor concentration and provide for air exchange in the space.

* * *

COMPUTERIZED MAILING LIST

The Safety Center is attempting to ensure that all active duty flight surgeons and reserve flight surgeons are receiving Approach, the Weekly Summary, the Flight Surgeon's Newsletter and the Annual Emergency Airborne Escape Summary. If you know of any flight surgeon who is not receiving this mailing, please send us (Code 30) his name and mailing address so that we can add him to the computerized mailing list.

* * *

MEDICAL BULLETIN ON FATIGUE

The following item was prepared by LT Clarence H. Spence, MC, flight surgeon attached to Helicopter Attack (Light) Squadron THREE, and forwarded by CAPT A. H. Munson, USN.

SUBJECT: FATIGUE

In view of the narrow tolerance for error in present day Naval Aviation, any factor which results in even minimal loss of efficiency warrants considerable attention. FATIGUE is not customarily considered as one of the major dangers in Naval Aviation; however, on some rare instances the fatigue brought on by continuous operation in a stressful environment may produce quite devastating results.

No adequate definition of fatigue has been established which will encompass all of its chemical, physical, psychological, and subjective facets. When dealing with humans, however, two general classes are usually accepted.

Chronic Fatigue

This type of fatigue results from the continuous strain of adjusting to daily occupational demands and is predominately psychological in nature. Chronic Fatigue will not only produce a serious loss of efficiency, but in its abnormal stages may lead to a psychoneuroses.

Acute Fatigue

This is the type of transient fatigue found in normal individuals following any period of strenuous effort or excitement. Effects of this type of fatigue may be completely eliminated by normal sleep, rest, and freedom from excitement. The acute fatigue encountered in aircraft operations has been termed as "Skill Fatigue," which characterizes certain changes in an aviator's level of performance such as:

1. Disruption of Sequential Timing:

Before a pilot is aware that he is suffering from any deleterious effects from fatigue, careful observation of his performance will indicate that although he is performing the individual components of a given task as well as previously, the timing among the manipulative efforts shows deterioration. The pattern of the operation is no longer the smooth affair it has been. He performs this operation as if it were a series of separate tasks and not an integrated activity.

2. Disruption of the Perceptual Field:

Here the individual will concentrate his attention on movements or manipulations in the center of his field of attention and neglect that in the peripheral aspects. At this time he may also begin to show loss in accuracy and smoothness of control movements, under and over control movements.

3. Subjective Aspects

These factors may include:

a. Increased physical discomfort
b. Growing irritability
c. Projection or irritability upon some component of the aircraft
d. Increasing awareness of performance, deficiencies and other subjective tensions
e. Progressive and unconscious lowering of performance standards

Causes of Fatigue

Primary factors vary and may include the following:

1. A variety of stresses, some personal and some a result of mental activity required in successful flight operations.
2. Mild hypoxia.
3. Stresses produced by the aircraft.
4. Physiological rationale: Under emotional excitement increased glandular secretions occur. This equips the body for prompt reactions in a stressful situation. The secretion of adrenalin stimulates the circulation and respiration, and energy is released from the liver to provide the extra fuel for brain and muscle work. The total organism prepares to respond to any challenge. As stressful situations occur frequently in flight, they may result in a loss of reserves. As soon as the culmination point of the mission is passed, a counter reaction takes place; the result is a state of general fatigue probably accompanied by a decrement of general working capacity.

Preventive Measures

1. Proper Sleep and Rest

Adequate sleep and rest is required to maintain the body's store of vital energy. Neuromuscular fatigue is alleviated and mental alertness is restored by sleep in favorable surroundings. Noises, excitement, and worry adversely affect the restfulness and diminish the benefits of sleep. The normal requirement for flying personnel is approximately eight (08) hours in every twenty-four (24) hours. Factors such as excessive fatigue, ill health and emotional stresses will increase this requirement. Flight schedules should be made with due consideration for watch standing and collateral duties. The latter should not be so time consuming as to interfere with adequate rest and preparation for primary flying duties.

2. Adequate Diet

Well balanced food intake should be such that the body will not be forced to consume its own tissues for food.

3. Elimination of Obesity

Obesity is incompatible with peak efficiency, longevity, and high standards of flight performance. Prompt correction of dietary excess and overweight is essential.

4. Exercise

It is an established fact that physical training opposes physical fatigue; the higher the level of physical condition, the better will be the overall inflight performance. Exercise in the form of play or recreation is further beneficial in relieving nervous tension and mental fatigue. Caution in this regard should be exercised as age advances and particularly where regularity of exercise periods cannot be maintained. While rest and relaxation are important to healthy young pilots, the habitual practice to lounge indoors is condemned.

5. Consultation

When in doubt - Always Punt!! Feel free to consult your squadron flight surgeon when there is a behavioral change in an individual's daily routine. The flight surgeon will listen to all problems - large, medium and small for the same price - A FEW MINUTES OF YOUR TIME. Remember: An ounce of prevention is worth more than a pound of cure.

References:

1. Harrison, T. R., Principles of Internal Medicine, 4th Edition, McGraw Co., New York, pp. 384-385.
2. Weiss, E., and English, O. S., Psychosomatic Medicine, 3rd Edition, W. B. Saunders Co., Philadelphia, pp. 318-321.
3. Aviation Medicine Training Safety Manual, 1961, Chapter 4.
4. OPNAVINST 3740.7 of 25 June 1957.

* * *

SMOKING, THE DESTRUCTION OF SELF

Estimation of the relative importance of epidemics is not meaningful, but the war in Vietnam, highway accidents, poverty, birth rates and smoking are prominent plagues of our time. The physician must assume his role of great service in all of these. The smoking epidemic charges him with a unique combination of social, moral and professional obligations. Reliance on collective responsibility has reduced his individual activity. Furthermore, the conscience and reason of educated men must be violated by the pundits engaged to cry, "The case against smoking has not been proved."

Personal trauma forces the urgency of action to a physician's conscious level. Such trauma may come from service to those dying of cancer of the lung, or from caring for cigarette addicts suffering the hell of terminal dyspnea from emphysema, or from treatment of postoperative pulmonary complications that are the lot of patients who smoke.

Pursuit of earlier diagnosis and treatment has failed to affect the campaign against lung cancer. A 5 per cent five-year salvage rate underscores this tragic situation. The problem would remain even if social conscience found unlikely haven, and the tobacco industry organized a hypothetical "Benevolent Order of Cigarette Producers" with the improbable public purpose of setting up free diagnostic centers in every country and free lung-resection centers in every state. To use cigarette profits to support such a "philanthropic effort" is no more absurd than associating femininity, virility and fun with smoking through television and radio commercials.

Smoking could be most effectively curbed if people did not start. Many would not start if an attractive smoking image were not pressed upon them. A potentially effective weapon in the public interest may exist in a newly formed foundation known as "Action on Smoking and Health" (A.S.H.). This is largely a consequence of the continuing efforts of John Banzhaf, III. Mr. Banzhaf reasoned that if cigarette smoking is a hazard to health, and that if this danger to the public is such as to require warnings on cigarette packages, it follows that the impressions widely transmitted through television and radio should be answered. Almost alone he took the matter before the Federal Communications Commission, which, on June 2, 1967, ruled that radio and television stations carrying cigarette commercials must make a reasonable amount of time available for messages spelling out the health hazards of smoking. This might amount to over 1000 antismoking messages a week. Even without effective enforcement the ruling has already had a wholesome effect. More and more American Cancer Society warnings about smoking are being broadcast. Our warnings about smoking are being broadcast. Our concepts of individual liberty are such that everyone should have a free choice in deciding whether or not to smoke, but it is also part of our tradition that the choice be well informed.

The response of the tobacco industry has of course been violent. It is appealing the F.C.C. ruling, which will be defended only by the F.C.C. and by A.S.H. The cigarette industry's contribution to its own "war chest" is monumental as compared with the trivial support available to A.S.H. The only advantage A.S.H. has is its moral position. Mr. Banzhaf directs the fight against the ruling. If the Federal Communications Commission ruling can be sustained, the public and established agencies such as the American Cancer Society, the American College of Cardiology, the American Heart Association and other organizations will, it is hoped, rally round to make most effective use of the expensive and educational time. The public might see smoking in its proper image. Smoking might be rendered socially unacceptable...To stop smoking is to curb lung cancer, emphysema and some forms of heart disease.

-Reprinted with permission from
The New England Journal of Medicine
Vol. 279, No. 5

* * *

FLIGHT LUNCHES

Recently the subject of possible pilot/co-pilot food poisoning from inflight lunches came up in a safety council meeting. Council members were well aware that many activities have local rules regarding preparation, handling and consumption of flight lunches; however, they did not know if there are any higher level directives governing this matter.

The Navy's Preventive Medicine Units under management control of the Bureau of Medicine and Surgery provide specialized advice and recommendations on food sanitation. Units are located at Norfolk; San Diego; Pearl Harbor; Naples, Italy; and DaNang, Vietnam.

Chapter I, Article 1-58 of Food Sanitation (Rev. 1965), of the Manual of Naval Preventive Medicine (NavMed P-5010) is particularly germane to the problem. In part in states:

1–58. Special Meals

(1) The 3-hour maximum time permitted for holding cooked protein foods at temperatures between 40° and 140° F. is of particular importance in the case of special meals (boat meals, flight meals, and recreation parties). When preparing and using sandwich fillings containing meat, meat food products, poultry, fish, or eggs, it is essential that close galley supervision and liaison with using units be maintained to insure continuous refrigeration. These foods shall be prepared and cooked in accordance with the methods prescribed in the Navy-Marine Corps Recipe Service. Such fillings shall not be held longer than *3 hours* between temperatures of 40° and 140° F. (total lapsed time in the galley and aboard aircraft or boats). Unopened cans of meat, chicken, and tuna may be issued in lieu of meat sandwiches when consumption is not anticipated within the 3-hour time limit between 40° and 140° F. In these instances bread and butter sandwiches may be issued with the canned items to permit members of the using unit to make their own sandwiches if they so desire.

(2) The preferred method of handling sandwiches for flight and boat meals is as prescribed in article 1-58(1). If it is not feasible to follow this procedure, sandwiches may be frozen and handled in the following manner:

(a) Freeze only freshly prepared sandwiches that contain ingredients suitable for freezing.

(b) Wrap each sandwich separately in a double thickness of heavy waxed paper or in moisture-vapor-resistant material. Fold wrapping material tightly and seal. Mark the wrapper, using a wax pencil to indicate that the sandwich has been frozen and the date of preparation.

(c) Immediately after wrapping, freeze sandwiches at 0° F., or below. Store at the same temperature. Do not store longer than 7 days.

(d) Inform using units that sandwiches shall be consumed within *5 hours from issue* (time shall begin when sandwiches are removed from the freezer).

(3) All types of flight rations shall be carefully packaged to preclude the risk of contamination and exposure during transit from galley to plane.

(4) Further information on special feeding conditions (such as battle meals) and subsistence operations in case of nuclear, biological, or chemical warfare may be found in the *BUSANDA MANUAL*.

* * *

Notes from Naval Safety Center Industrial Hygienist

TEFLON DECOMPOSITION "FUMES": A POTENTIAL BREATHING OXYGEN CONTAMINANT

Recent incidents/accidents indicate that when aircraft oxygen/converter systems are subjected to extreme heat (as from fire) the breathing oxygen can become contaminated and quite odorous. Prolonged exposure to this gas could conceivably result in adverse effects from breathing teflon decomposition "fumes." The following excerpts from a recent Aircraft Accident Report illustrate the problem, although "teflon" is not mentioned in the report:

"Pilot (A-4) noted faint odor in O_2 mask...at 200' noted a loud bang and strong fumes in his O_2...landed and on rollout lost his O_2 and pulled off the face mask...found that tailpipe clamp had come apart allowing exhaust to blow inside fuselage, igniting the O_2 converter."

The NATOPS Flight Manual (A-4) indicates that actual fires are nearly always accompanied by odor in the O_2 system. Safety analysts indicate that the odors can be due to heat decomposition of the teflon seals in the O_2 converter system. In some cases the seals may give way allowing toxic byproducts from the fire to get into the breathing system. Recommendations for this type of emergency, when O_2 is cut off or becomes contaminated, is to turn the O_2 off and pull the "green-ring" (seat pan bailout emergency O_2 bottle). The alternative is to remove the mask and select ram air.

An important message here is that following fire there is a potential exposure to both carbon monoxide (CO) and teflon decomposition products. Pilots exposed to these toxicants should be monitored closely by the flight surgeon until all physical symptoms and signs have cleared.

The effects of inhalation of teflon decomposition products is continuously being researched and is worthy of review here. Literature indicates that the effects are related to the temperature developed and to the type of plastic. At normal temperatures teflon is inert. Even at temperatures up to 250°C it is unlikely that significant amounts of any harmful material would be evolved. With commonly used types of teflon, temperatures of 300-360°C generally will evolve some irritating vapors and gases, such as hydrogen fluoride. At about 380°C and above, small amounts of highly toxic octafluoroisobutylene are found. Animal experiments indicate this material can cause severe pulmonary edema. In the range of 340-385°C and above, the decomposition "fumes" have produced in humans a "polymer fume fever" (the "shakes"). This syndrome is similar to "metal fume fever," and resembles an attack of influenza, but recovery is rapid, usually occurring within 48 hours. The illness can occur in industrial situations when workmen smoke cigarettes which have been contaminated with teflon dust. Very recent data shows that at temperatures above 500°C, much carbonyl fluoride (COF_2) is evolved. This is a powerful irritant which hydrolyzes on contact with moisture to form hydrofluoric acid which is very corrosive to mucous membranes.

There is no established practicable method for evaluating the extent of exposure to teflon "fumes" in the foregoing type of episode. The influenza type symptoms may be caused by inhalation of very small quantities of the decomposition products noted above. These symptoms often do not appear until two to six hours after exposure. If it can be assumed, from history of subjective reaction, that significant exposure has occurred, the exposed person should be kept under observation. Suspected exposure or development of the symptoms noted would indicate a need for temporarily "grounding" the airman.

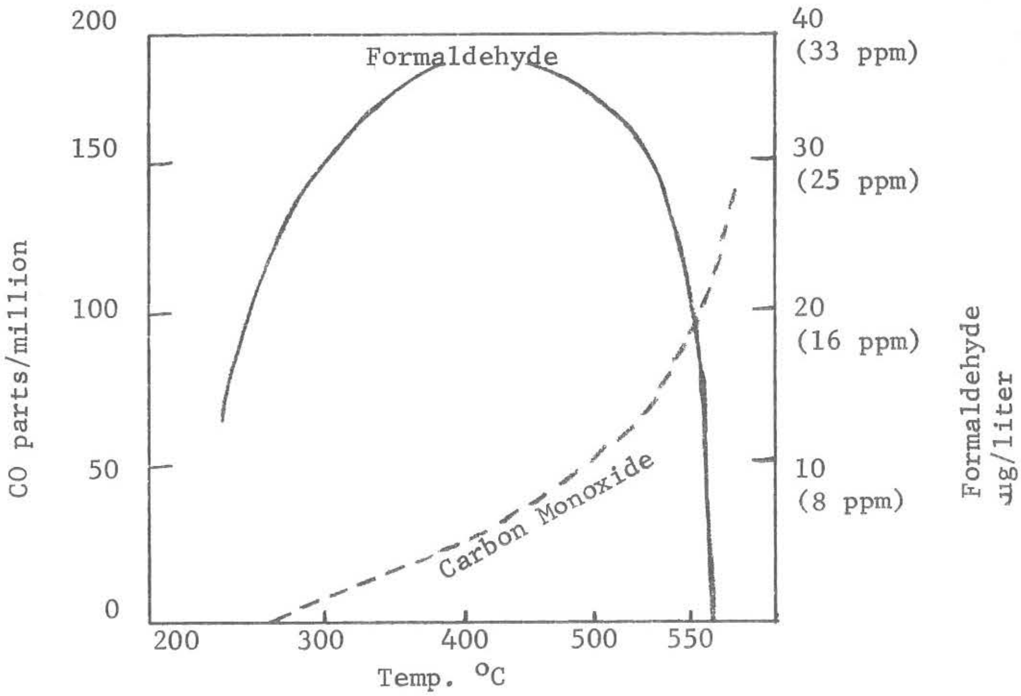
* * *

TF-30 ENGINE, SMOKE-IN-COCKPIT PROBLEM

Message traffic over the past few months has indicated a recurring problem of smoke-in-cockpit due to synthetic lube oil (MIL-L-23699) leaking by seals in the TF-30 engine in A-7 aircraft. The oil becomes pyrolized (decomposed due to engine heat) and smoke and toxic by-products enter the bleed air taken off the 16th stage compressor for air conditioning the aircraft cockpit. The smoke generation has occurred on the ground, generally within a couple of minutes during run-up of a cold engine to full power. Pilot reactions were chiefly related to irritations, particularly to the eyes.

NARF Norfolk engineers, after consultation with the NAS Industrial Hygienist and Naval Safety Center Aero-Medical representative, sought to develop a testing procedure for assurance against recurrence of this problem after repair of the TF-30 engines. A literature search by Naval Safety Center revealed that the Royal Army Medical Corps (Porton, England) had conducted in 1960 both animal and human research on the effects of exposure to synthetic oil breakdown products. The synthetic oils tested differed chemically from our MIL-L-23699 but it can be inferred that the oxidation by-products would potentially contain similar toxic chemicals, including significant amounts of carbon monoxide, formaldehyde and acrolein. The latter two chemicals are very irritating to the eyes.

The British data was based chiefly on exposures of animals and humans to oil breakdown products from a concentration of .2 mg of oil per liter of air, <u>assumed</u> by British jet aircraft manufacturers to be the maximum probable amount of cabin air contamination. At temperatures below 500°C the carbon monoxide did not exceed 400 ppm, but the relatively high concentration of formaldehyde (very irritating) proved to be a useful warning. Above 500°C, carbon monoxide (CO) increased rapidly and the formaldehyde concentration fell away, so the formaldehyde irritation warning could be lost at these high temperatures. The above phenomena is shown in the following chart:



According to the above data, the maximum production of formaldehyde would be extremely unpleasant for a pilot and eye irritation (tears) would seriously interfere with instrument reading, but there would be no significant danger of sudden loss of consciousness from either the formaldehyde or the carbon monoxide.

Based on this available data, NARF engineers are proceeding to develop a simplified testing procedure to assure that there are no significant toxic by-products entering the bleed air after repair of TF-30 engines. Air will be taken directly off the appropriate compressor stage of the engine, routed continuously into a 1-2 cubic foot clear plastic box where sampling will be conducted by detector tubes for carbon monoxide and formaldehyde, and reactions will be observed for significant odors and eye irritation effects.

The efforts of the NARF engineers are commendable and this simple testing approach has possible application to other smoke-in-cockpit incidents. A review of reported serious smoke-in-cockpit incidents in all naval aircraft shows that approximately 70 occurred in the 1963-67 period, with many of these related to oil decomposition "fumes."

-John Maccioli

* * *

Aerospace Physiologist's Section

This new section of the Newsletter will be devoted to informational material of concern to the aerospace physiologist. We will try to keep readers abreast of the latest in safety information and equipment as related to the field of physiology. From time to time we will present articles based on Medical Officer's Reports of specific aircraft accidents which involve training technique or equipment that should be of interest to the reader. However, the output of this publication can only be as good as its input. With this in mind, all addressees within the scope of this section are urged to submit any material, inquiries or subjects of interest they may wish to propose for this section of the Newsletter. Please address mail to:

Naval Safety Center (Code 321)
Naval Air Station
Norfolk, Virginia 23511

* * *

An incident of suspected hypoxia in a TF-9J brings to light an interesting note concerning the H-2 bailout oxygen systems. The system allows approximately 1-2 minutes emergency oxygen vice 10 minutes (a figure often remembered by aircrewmen). The time of flow may increase with altitude but not to any great degree. This information is apparently not generally known by many in the field of aviation and should be stressed in all Aerospace Physiology Training Unit presentations. Equipment lecturers should also make the effort to become familiar with at least the approximate flow times of emergency oxygen systems utilized in the specific ejection seats taught in your areas. The squadron Safety and Survival Officer should also keep the aviator informed on such equipment.

* * *

A recent article in Approach magazine related the concern of a rear seat passenger in a T-2A when he observed the wingman signalling the pilot to "eject." Upon questioning the pilot, he received no response and considered initiating his own ejection until finally the pilot answered. The wingman was indicating that he had made a "kill" and had won the dogfight.

Back seat riders should always confirm hand signals with their pilots to be sure there are not other intended uses for the standard. If you are not sure, ask!

DREAM ENVIRONMENT

In today's world of sophisticated equipment it would seem that a reliable personal protective escape system could be designed to enable complete, unhindered egress from our modern jet fighter aircraft and also provide acceptable comfort. This writer has no doubt that many engineers and scientists have envisioned their own systems and this one will be offered only as food for thought.

In the complex man/machine mode, more consideration appears to be given to the machine than to the operator. This is true not only now but it seems to have been true for many years or perhaps since the inception of the flying machine. The "dream environment" outlined here will consider man (the operator) as the most important element.

Consider the man himself for after all is he not the most important element of the man/machine compound? Consider the man who is carefully fitted with some 35 to 40 lbs of equipment and gently placed in a small, cramped space, seated on an armed, occasionally easily actuated, escape system and asked to perform at his maximum capability. Is this any way to treat the most important element?

It is true that the operator must first be supplied with a safe environment, one that allows for egress/escape in the event of an emergency and also one which provides for comfort. In a "dream environment," comfort, often considered nice to have, is important. In most cases, a man performs better when comfortable or when he is provided usable space to operate in.

I dream of a cockpit which can by choice be separated from the engine plant of the aircraft in an emergency, then provide its own power and allow slow descent to a safe landing area. Perhaps rocket motors properly placed for both horizontal firing (controlled forward movement) or vertical firing (controlled descent rates) could be utilized. Parachutes to lower the cockpit with forward rocket control are another consideration. The system could also supply its own flotation in the event of water entry.

I dream of an environment which allows complete comfort for the operator while also providing a safe environment. Padded equipment panels, overhead structures and consoles would help prevent some injuries. With the elimination of seat/cockpit separation, it (the seat) could be made wider, adjustable to form to body contours, padded, softer and generally more comfortable. Heating and cooling systems could be provided for use, both attached and separately from the engine assembly. Perhaps instrumentation could be condensed so that one panel performs many functions. Improved emergency warning systems could be developed. The improvement of instrument design and better lighting would perhaps reduce the time required to discover an emergency. Combining panels should provide more space within the cockpit to enable easier and quicker operation.

I dream of an environment which would also allow for the deletion of excessive man-mounted survival equipment. Storage of survival equipment could be provided within the cockpit for use upon landing. I dream of the introduction of lightweight protective helmets and comfortable fire resistant flying suits, the use of oxygen systems within the cockpit and a rapid donned mask system in the event of pressure loss. Perhaps a self-sealing cockpit could prevent the loss of pressure in the emergency configuration (separated from engine section). Many more items could be considered in an attempt to develop a safe, more comfortable and more useful environment.

I believe it is a general feeling that more thought must be given to the physiological and psychological needs of the aircraft operator during the design phases. Some of the "dreams" listed are becoming reality even now, and this will continue to be true. The "dreams" of today may very well be the reality of tomorrow.

-LT W. F. Cunningham
Aerospace Physiologist

* * *

Aerospace Psychologist's Section

FSNL - 4th Quarter 1968

The annual meeting of the Navy Medical Service Corps Psychologists, held at the San Francisco Hilton on 30 August 1968, was well attended, especially by aerospace experimental psychologists from Pensacola, Norfolk and Point Mugu.

Papers were presented by CDR Mike Connery of ASWFORLANT and LCDR Jim Johnson and LTJG Jerry Trexler of COMFAIRWINGSLANT on the human factors work they are doing in Norfolk on the ASW mission. LTs Bob Kennedy, H. R. Ramsey, George Rickus, Jr., Dick Booth and Lew Waldeisen reported on their work with flight trainees at the Naval Aerospace Medical Institute using computers and factor analytic techniques. LCDR Bob Wherry, Jr. talked about human factors techniques in the evaluation of weapons systems at Point Mugu. From the clinical side we heard from CDR N. H. Berry about the status of military psychology in Europe; LCDR C. W. Buck told about his work with the SERE program and LTJG R. P. Keen related his experiences with the Marines in Viet Nam. A well done goes to LCDR P. D. Nelson and to all concerned for arranging and contributing to an interesting and informative meeting.

The Navy exhibit at the Jack Tar Hotel was a great success. The theme of the exhibit was the varied roles of psychology in support of the mission of the Navy and Marine Corps.

A study of aircrew fatigue on ASW missions is being conducted for the Naval Safety Center as part of the Human Error Research and Analysis Program (HERAP) project at NAS Los Alamitos using an S-2D simulator at the Reserve ASW Tactics School there. McDonnell-Douglas Aircraft Co., Douglas Division, of Long Beach is performing the study under the HERAP contract funded by NAVAIRSYSCOMHQ.

Physiological and psychological data being collected will be analyzed to enable researchers to determine those measurements which will be the most valid for in-flight data recording at a future date. Information obtained from such studies may be useful in determination of mission parameters of future airborne ASW systems, such as is being contemplated with the current VSX project.

* * *

Articles of interest to aerospace experimental psychologists or other psychologists working in safety or human engineering are being solicited for inclusion in future issues of the quarterly Flight Surgeon's Newsletter. If you are doing some interesting research with safety implications, or have some important news or just want to pass the word about activities, meetings, etc., please write to:

Naval Safety Center (Code 31)
Naval Air Station
Norfolk, Virginia 23511

* * *

APPLICATIONS OF AVIATION HUMAN ERROR RESEARCH TO AUTOMOTIVE SAFETY

Following is a summary of a paper presented by Dr. Robert A. Alkov of the Naval Safety Center at the 4th Annual Meeting of the Association of Aviation Psychologists during the 76th Annual Convention of the American Psychological Association in San Francisco.

SUMMARY

The suggestion was made that drivers be given compulsory training and periodic physical examinations for licensing as is required of pilots. This information along with data from accidents could be incorporated into a data bank and factor analysis applied in order to reveal those characteristics of the "accident prone" driver, if any. A standardized automobile accident reporting format would have to be developed in order to obtain reliable data. Also a medical doctor's evaluation of the psychophysiological factors present during the accident would be needed. The biggest problem, however, would be to obtain such psychophysiological data on normative (non-accident) samples as well. Critical incident reporting techniques, while revealing, would have questionable validity and an understandable bias.

The major contribution of aviation human engineering research to automotive design has been in enhanced crashworthiness. What is badly needed is standardization of the man-machine interface in the automobile, including lighting, anthropometry, control movements (including pressures required to move them), and display design. Studies of the handling qualities of automobiles are also needed. The relationships between psychophysiological variables and vehicle stability and control should be investigated. Time required and time available for performing accident prevention acts in emergencies should be reported.

There have been a large number of studies done on drivers' perceptions and reaction times, but the intervening variables (such as cognitive processes) have been largely ignored due to difficulties in making precise measurements. Perhaps clinical psychologists can contribute by studying such processes as driver decision making, risk taking,

knowledge of alternatives, motivations, expectations concerning outcomes, etc. Driver decisions will tend to be influenced by the controls which are available to implement them. The interaction of vehicle handling properties with unfavorable driver and highway conditions need to be investigated. Expert drivers should test new vehicle designs to reveal handling idiosyncrasies which then may be corrected by redesign or reported in a drivers' manual. Such manuals would be as useful to the driver as the pilots' manuals are to the aviators.

Finally, the apathy of the public toward the goals of automotive safety programs might be allayed through the use of motivational research techniques, for it is ultimately public opinion which will contribute the impetus to the government and industry for the implementation of the findings of safety research.